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STATE DOCUMENTS

ECONOMIC ANALYSIS
OF
INTERSTATE HIGHWAY ROUTINGS

FROM

HELENA

TO

WOLF CREEK VICINITY

PREPARED BY

PLANNING SURVEY DIVISION

AND

INTERSTATE DIVISION

OF

MONTANA STATE HIGHWAY COMMISSION

IN COOPERATION WITH

U. S. DEPARTMENT OF COMMERCE

BUREAU OF PUBLIC ROADS

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INTERSTATE ROUTE I-15
HELENA - WOLF CREEK

SITUATION MAP
of
ALTERNATE ROUTES

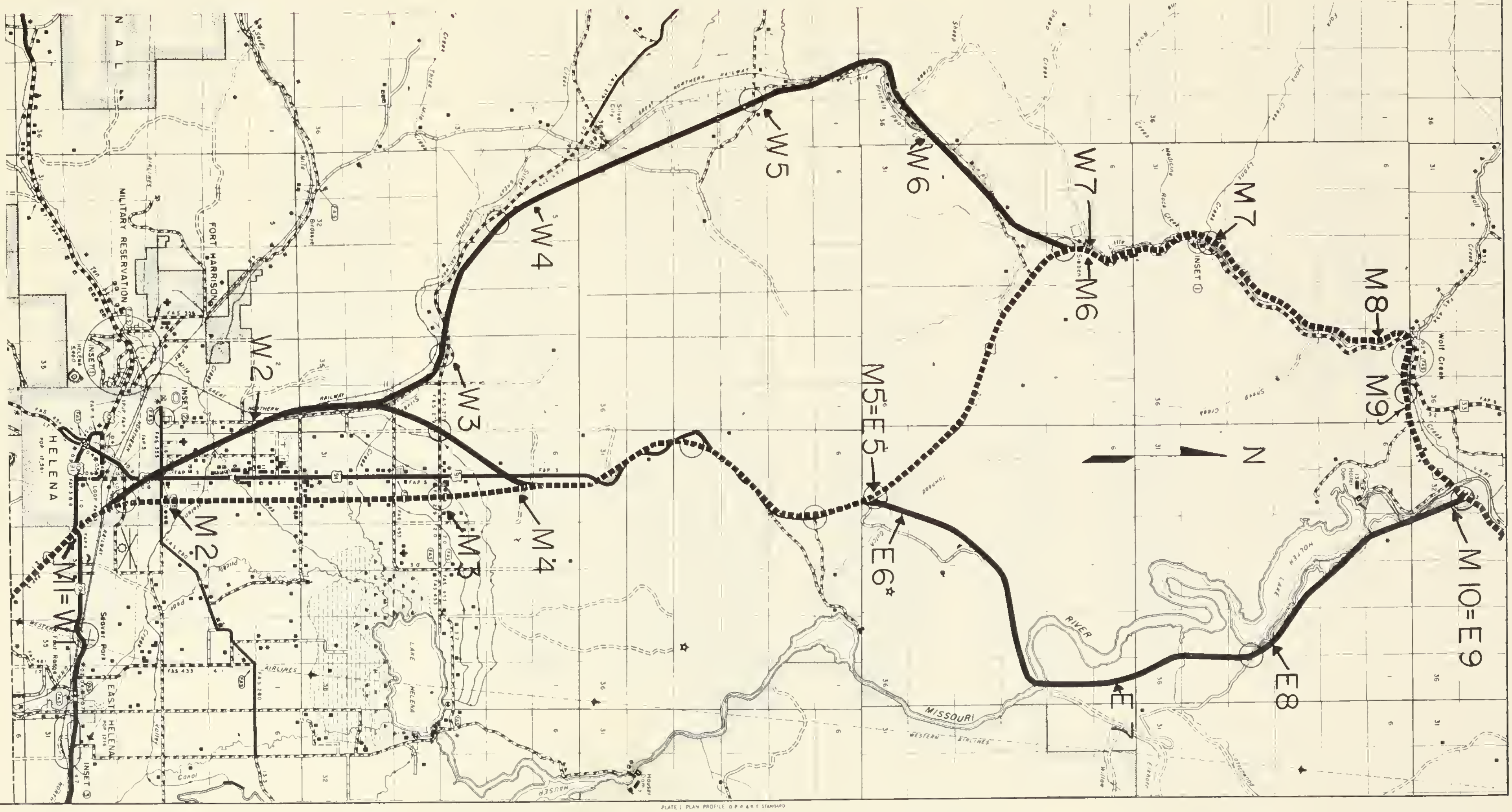

PLATE 1 PLAN PROFILE G P P & R C STANDARD
KEUFFEL & ESSER CO. NEW YORK

ECONOMIC ANALYSIS OF ALTERNATE ROUTINGS
OF INTERSTATE HIGHWAY NO. 15
BETWEEN HELENA AND WOLF CREEK VICINITY

FOREWORD

An economic analysis of this type is prepared for the purpose of comparing the relative merits of alternate highway routings where more than one routing appears to be feasible and the situation is of sufficient importance to warrant a detailed investigation.

The analysis gives consideration to all features which can be appraised however, principal attention is given to those features which are of primary interest to the highway user and which can be evaluated in monetary terms.

Federal and State funds for the construction and maintenance of highway facilities are derived almost entirely from taxes and fees paid by the highway user. For this reason, the highway user is vitally interested in the selection of a highway routing which involves the most judicious and economical expenditure of his tax money.

The highway user also pays the cost of operating his motor vehicle on the highway facilities, and for this reason, he is also vitally interested in the selection of the highway routing which will permit the most economical operation of his motor vehicle. In the final analysis, the most favorable highway routing for the highway user is the one that involves the lowest overall cost when construction, maintenance and vehicle operating costs are all taken into consideration.

Another comparison of interest is included in the relationship between the value of benefits to the highway user to be realized from the new highway construction and the corresponding investment of money required to achieve these benefits. This is known as the benefit/cost ratio.

DESCRIPTION OF ROUTES

This analysis deals with three alternate routings of the Interstate highway between Helena and the Wolf Creek vicinity as investigated and selected by the Interstate Division. For identification purposes, these routes are described as the MIDDLE ROUTE, EAST ROUTE and WEST ROUTE in relation to their general geographic position. The locations are shown on enclosed maps.

The southern portions of the Middle Route and the East Route follow a coincident line. The northern portions of the Middle Route and the West Route also follow a coincident line.

The Middle Route begins at a point of common terminus with the other routes at a proposed interchange near the present intersection

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of U.S. 12 and U.S. 91 near the east edge of Helena. This route extends in a northwesterly direction through the relatively undeveloped northeast section of the city to another interchange in the vicinity of Cedar Street. Between these two interchanges, the route crosses a group of railroad tracks.

From the Cedar Street interchange, the Middle Route extends in a northerly direction across the Helena valley on a location about one-half mile east of the present highway (U.S. 91). The crossing of the valley is located through a developed farming area, and it bisects a future proposed suburban housing development. At Control Point M-3, an interchange is located at the intersection with FAS Route 279, an important east-west Secondary System road at the north edge of the valley.

Beyond this interchange, the route veers in a northwesterly direction until it reaches and follows the general alignment of the present highway to Wolf Creek and Great Falls. A gradual climb is begun at the north edge of the valley as an approach to a ridge defining the north boundary of the valley. The crossing of this ridge involves significant grades and curvature, with a rise of about 900 feet above the valley floor and a fall on the north side of about 700 feet.

After crossing the ridge, the Middle Route crosses a series of minor drainage courses until a large flat is reached where a gradual descent is begun to the small valley of Little Prickly Pear Creek. At Control Point M-6, the route enters the lower Little Prickly Pear Creek canyon.

The location through this canyon from Control Point M-6 to the Wolf Creek vicinity represents a major construction problem. It is a narrow canyon with crooked alignment, and the highway must compete with a railroad and a major telephone line throughout its length. A gas pipeline is also located in the northern half of the canyon. At several places, steep cliffs crowd the stream and pinch the canyon to a narrow width. In general, this section of canyon may be described as a difficult and costly place in which to construct a highway to Interstate System standards.

Some difficulty will also be encountered in locating the highway through the area embracing the Wolf Creek community. Mountainous terrain surrounds the community, and all available land is being used for residences, service establishments, or other types of development. The exact location through this area will require further study; however, it appears certain that it will be necessary to remove several buildings in order to obtain sufficient width for a highway of Interstate System standards.

From the Wolf Creek community to the northern terminus, the Middle Route enters the area of the Missouri River valley. This is rolling terrain with no special construction problems other than the construction of a bridge over the Missouri River.

The length of the Middle Route is 37.6 miles. It involves 10.3 miles of two-lane highway and 27.3 miles of four-lane highway.

The East Route follows the same line as the Middle Route from the southern common terminus at Helena to Control Point M-5(E-5). At this point the East Route leaves the present highway and crosses a fairly wide valley with rolling terrain. At the north edge of this valley, the route enters a small canyon and begins climbing towards a pass which leads to the Missouri River valley and Holter Lake. About 600 feet of rise and about 700 feet of fall are involved in the crossing of this pass.

A crossing of the Missouri River is proposed at one of the narrower points on Holter Lake. A long structure will be required with deep footings. The route then follows along the east shore of Holter Lake to a point of intersection with a local road in this vicinity. An interchange is proposed at this junction.

The East Route continues to follow along the east shore of the lake to the northern common terminus at Control Point M-10 (E-9) north of Wolf Creek. Through this area, the route crosses numerous drainage courses of some depth, and considerable rise and fall and curvature are involved.

After the East Route enters the canyon north of Control Point E-6, it is located through an area where difficult construction problems will be encountered. There will be much heavy excavation and rock excavation. Much of the bedrock is of fractured, sedimentary material of the shale type and is bedded at a steep, adverse angle. Major slides could be a possibility at several places.

The length of the East Route is 35.2 miles, with the entire length being four-lane highway.

The West Route was selected as a location which would avoid most of the developed area of the Helena valley and would also eliminate the need of crossing the ridge north of the valley.

The route is coincident with the Middle Route and the East Route from the southern terminus to the Cedar Street interchange. At this point, it veers in a northwesterly direction across a small farming area until a county road is reached. It then follows along the county road parallel to the railroad until it reaches a point of intersection with FAS Route 279 leading to Canyon Creek and Lincoln. An interchange is proposed at this junction.

This location through the Helena valley will affect a small amount of farming land, but for most of the distance, the land is idle or is used for grazing purposes. The location adjacent to the railroad and mountain front eliminates the problem of land segregation. The population through this area is sparse.

After reaching FAS Route 279, the West Route will overlay or be in close proximity to this highway for a distance of about four miles. This is rolling terrain with some curvature. The route then leaves the present secondary highway and follows a direct line to another interchange with a local road at Control Point W-5. This is predominantly grazing land through this area. The terrain is generally flat.

Beyond Control Point W-5, the West Route enters upper Little Prickly Pear Creek Canyon. This is the beginning of another section of difficult highway construction. Although the canyon is not as narrow or the terrain as rugged as the lower canyon described under the Middle Route, difficulty will be encountered in constructing a highway to Interstate System standards. The canyon is presently occupied by the railroad, a gas pipeline and a major telephone line. The county road through this canyon is quite narrow and crooked. It crosses the stream and the railroad at two places.

The West Route joins the present highway and the Middle Route at Control Point M-6 (W-7). From this point to the northern terminus, the West Route and the Middle Route follow the same line.

The length of the West Route is 39.2 miles. It includes 11.7 miles of two-lane highway and 27.5 miles of four-lane highway.

Sheets are enclosed which show aerial photography of the terrain along each proposed route and the approximate profile for each route.

TRAFFIC SERVICE

As mentioned in the foreword, vehicle operating costs are a major consideration in the selection of the most favorable highway routing. It is necessary, therefore, that each alternate route be analyzed to determine the volume and types of traffic that will be served under the different locations. New locations will also change existing traffic patterns, with certain benefits accruing to traffic which will be served by highways of a higher standard than the existing facilities.

For example, the selection of the West Route would confer substantial benefits on those motorists who are currently using low-standard local roads in the area between Silver City and Sieben. Conversely, however, the construction of the Interstate highway on the line of the West Route would eliminate the possibility of the construction of an Interstate highway on the line of the Middle or East routes. The people using these other routes would therefore be deprived of the benefits of using an Interstate highway.

The relationship between traffic service and benefits can be determined by appraising the amount of traffic using different types of

facilities under present conditions and by re-evaluating the service and usage of different facilities under each of the proposed Interstate System highway locations. A pre-requisite to the computation of these benefits involves the assignment of traffic to the Interstate routes and the appraisal of the manner in which traffic patterns will change.

In appraising the traffic service to Helena and the Helena valley, it appears that none of the alternate Interstate routes will materially affect present traffic patterns. The locations of interchanges at the east edge of Helena and at Cedar Street will permit traffic entering or leaving the city to follow quite closely the routings that are used under present conditions. There will be a benefit, however, for the through traffic which does not wish to enter the city. This traffic will be able to use the Interstate System in place of traveling a greater distance on the more congested city streets in getting through the city.

The location of the Middle Route and the East Route through the Helena valley will be on a line about one-half mile east of the present highway. Access to the Interstate highway may be obtained only at the Helena interchanges or at the interchange with FAS Route 279 at the north edge of the valley. Under these conditions, it is improbable that the residents in the main part of the valley will travel additional back-track mileage in order to enter the Interstate highway for travel to and from Helena. It may be expected that these trips will continue to follow the present highway or the oiled frontage road which will be constructed on the east side of the Interstate highway.

The Middle and East routes will have the advantage, as compared with the West Route, that they will provide Interstate highway service for traffic entering the M-3 interchange from east FAS Route 279 and FAS Route 453 in travel to Helena and points beyond. This traffic would not be able to use the West Route because of its remoteness from the central area of the valley.

The West Route will also be of little value to the traffic in the Helena valley. This route is located at considerable distance from the more populated area of the valley. It would also involve substantially greater distance for travel to and from the city. For these reasons, it may be assumed that there would be no diversion of local valley traffic to the West Route. The existing traffic in the valley could be expected to continue using the present highway and connecting roads.

The great majority of the trips using the present highway north of the Helena valley have origins and destinations beyond the termini of the alternate routes. Because of the attractiveness, speed, safety and convenience of travel on the Interstate System as compared to the present highway, it has been assumed that all of these through trips would use any one of the alternate Interstate routes, and they have been assigned in

equal amount to each of the routes.

The remaining problem, then, is to appraise the service which each of the alternate routes would provide to traffic with trip origins or destinations between the Helena valley and the common northern terminus.

The Middle Route would continue to serve traffic on the present highway between these points, and this traffic would be provided the benefit of traveling on the higher-standard Interstate highway in place of the present highway which is particularly obsolete through the lower Little Prickly Pear Creek Canyon. A substantial portion of this traffic consists of persons picnicking, hunting and fishing in this canyon.

The East Route would serve the same types and volumes of traffic as the Middle Route to the separation point at Control Point M-5 (E-5); however, the location of the interchange for the East Route at Control Point E-5 would require that trips to the boat landing incur some extra mileage of back travel. The East Route would not serve the recreational travel to the Little Prickly Pear Creek Canyon and it would provide poorer service for travel to and from Wolf Creek and Montana Highway 287 leading towards Augusta. These deficiencies would be offset to some extent by better service to a recreational area near the Gates of the Mountains and to recreational traffic now using the east side of Holter Lake.

Since the East Route will create a new scenic route and will open up new recreational areas, it may be assumed that it will attract new traffic to this area. Some of this traffic will probably be diverted from the present recreational area in the Little Prickly Pear Canyon; other traffic will likely be diverted from other recreational areas outside the scope of this analysis. It is characteristic, however, that traffic to new attractions diminishes with time as the novelty of the new situation wears off.

The West Route will provide considerable benefit to traffic now using county roads between Control Points W-4 and W-7. It will also provide service equal to that of the Middle Route for traffic in the lower Little Prickly Pear Canyon and the Wolf Creek area. It will not, however, be of any benefit to local traffic along present U.S. 91 between the Helena valley and the Sieben area or to traffic which is destined for the Gates of the Mountains boating area.

The West Route will also be of little benefit to residents of the main part of the Helena valley. Since this route is located at the far west edge of the valley and at considerable distance from the main developed portion of the valley, there is little possibility

that the residents of the valley would travel substantially greater distances to reach the Interstate highway in travel to and from Helena. These residents would find it much better to use the present highway for such travel.

These various traffic assignment considerations, as described in the foregoing, have been analyzed with the results in Table No. 1 showing the volumes and distribution of traffic under present conditions and the redistribution of traffic under each of the routing proposals. It should be emphasized that this table pertains only to traffic which would be affected by the new routings. Any traffic which would not be affected by the new routings, such as the local Helena valley traffic on U.S. 91, has been omitted from the computations.

TABLE NO. 1

RESULTS OF TRAFFIC ASSIGNMENT

PRESENT CONDITIONS	MILES	AVERAGE DAILY TRAFFIC	DAILY VEHICLE-MILES OF TRAFFIC	PERCENT DISTRIBUTION BY SYSTEM
Interstate - Rural	- - -	- - -	- - -	- - -
Interstate - Frontage	- - -	- - -	- - -	- - -
Primary - Rural	38.1	1,157	44,064	68.00
Secondary - Rural	8.5	157	1,332	2.06
County Roads	25.0	20	500	0.77
City Street	3.7	5,110	18,908	29.17
TOTAL	75.3	861	64,804	100.00
MIDDLE ROUTE				
Interstate - Rural	37.6	1,047	39,344	62.11
Interstate - Frontage	6.1	907	5,533	8.73
Primary - Rural	2.5	164	410	0.65
Secondary - Rural	8.5	157	1,332	2.10
County Roads	25.0	20	500	0.79
City Streets	3.7	4,385	16,224	25.62
TOTAL	83.4	759	63,343	100.00

TABLE NO. 1 (continued)

RESULTS OF TRAFFIC ASSIGNMENT

EAST ROUTE	MILES	AVERAGE DAILY TRAFFIC	DAILY VEHICLE-MILES OF TRAFFIC	PERCENT DISTRIBUTION BY SYSTEM
Interstate - Rural	35.2	973	34,251	55.29
Interstate - Frontage	6.1	907	5,533	8.93
Primary - Rural	24.7	171	4,227	6.82
Secondary - Rural	8.5	157	1,332	2.15
County Roads	15.0	26	383	0.62
City Streets	3.7	4,385	16,224	26.19
TOTAL	93.2	665	61,950	100.00

WEST ROUTE	MILES	AVERAGE DAILY TRAFFIC	DAILY VEHICLE-MILES OF TRAFFIC	PERCENT DISTRIBUTION BY SYSTEM
Interstate - Rural	39.2	934	36,599	56.94
Interstate - Frontage	- - -	- - -	- - -	- - -
Primary - Rural	26.6	411	10,923	16.99
Secondary - Rural	2.5	120	300	0.47
County Roads	11.5	20	230	0.36
City Streets	3.7	4,385	16,224	25.24
TOTAL	83.5	770	64,276	100.00

It may be noted from the foregoing table that the East Route, with a total of 61,950 daily vehicle miles of traffic, involves less travel than either of the other alternate routes. This amount of traffic is 2.20% less than the Middle Route and 3.62% less than the West Route. This advantage results principally because the East Route is 2.4 miles shorter than the Middle Route and 4.0 miles shorter than the West Route.

This advantage of reduced travel is offset to considerable extent by the fact that the East Route, with 55.29% of the total travel on the Interstate highway, serves a lower proportion of the total traffic on Interstate facilities than either of the other alternate routes.

Table No. 2 presents a comparison of traffic on various segments of the alternate Interstate routes:

TABLE NO. 2

TRAFFIC ON INTERSTATE SYSTEM

BETWEEN INTERCHANGES	MILES	AVERAGE DAILY TRAFFIC	DAILY VEHICLE-MILES OF TRAFFIC
MIDDLE ROUTE:			
M1 to Cedar Street	1.4	725	1,015
Cedar Street to M3	6.5	1,371	8,913
M3 to M5	9.0	995	8,955
M5 to M6	8.8	985	8,668
M6 to M10	11.9	991	11,793
TOTAL	37.6	1,047	39,344
EAST ROUTE:			
M1 to Cedar Street	1.4	725	1.015
Cedar Street to M3	6.5	1,371	8,911
M3 to M5	10.2	995	10,149
M5 to E9	17.1	829	14,176
TOTAL	35.2	973	34,251
WEST ROUTE:			
M1 to Cedar Street	1.4	725	1,015
Cedar Street to W3	7.6	1,012	7,691
W3 to W4	3.5	991	3,469
W4 to W5	5.9	872	5,145
W5 to W7	8.9	855	7,610
W7 to M7	2.8	940	2,632
M7 to M10	9.1	993	9,037
TOTAL	39.2	934	36,599

VEHICLE OPERATING COSTS

The section of this report pertaining to TRAFFIC SERVICE has described the process of assigning traffic to the different highway systems involved in the overall transportation situation in the area between Helena and the Wolf Creek vicinities. This section of the report also reports the daily vehicle-miles of traffic as computed for each type of highway facility. If all types of highway facilities had the same type of surface and the same operating conditions, with the same proportion of passenger cars and trucks, the daily vehicle-miles of traffic shown for each of the alternate proposals would be a valid comparison of the service value of the routes.

There is a substantial difference, however, in the costs of operating vehicles on the different types of highway facilities with a range extending from highest costs on low-standard county roads and congested city streets to the lowest costs on the high-standard Interstate system facilities. In order to obtain a composite total of vehicle operating costs on all highway facilities under the different alternate route proposals, it is necessary to multiply the vehicle-miles of traffic on each type of facility by the unit vehicle operating costs applying to that facility.

The results of these computations are shown in Table No. 3. Annual vehicle miles of traffic are used so that the vehicle operating costs may be reported on an annual basis in order to permit the combining and comparing of these costs with annual costs for highway construction and maintenance. The unit costs shown are a weighted average of passenger car and truck costs, with consideration being given to the additional cost incurred in overcoming rise and fall and curvature encountered on specific sections of each route.

TABLE NO. 3

VEHICLE OPERATING COSTS

	MILES	ANNUAL VEHICLE-MILES OF TRAFFIC	UNIT COST PER VEHICLE-MILE	TOTAL VEHICLE OPERATING COST
PRESENT CONDITIONS				
Interstate - Rural	- - -	- - -	$- - -	$ - - -
Interstate - Frontage	- - -	- - -	- - -	- - -
Primary - Rural	38.1	16,083,360	.1595	2,564,503
Secondary - Rural	8.5	486,180	.1232	59,893
County Roads	25.0	182,500	.1683	30,722
City Streets	3.7	6,901,420	.1631	1,125,846
TOTAL	75.3	23,653,460	$ .1598	$ 3,780,964
MIDDLE ROUTE				
Interstate - Rural	37.6	14,360,560	$ .1258	$ 1,805,868
Interstate - Frontage	6.1	2,019,545	.1241	250,661
Primary - Rural	2.5	149,650	.1627	24,350
Secondary - Rural	8.5	486,180	.1232	59,893
County Roads	25.0	182,500	.1683	30,722
City Streets	3.7	5,921,760	.1618	957,891
TOTAL	83.4	23,120,195	$ .1354	$ 3,129,385

TABLE NO. 3
VEHICLE OPERATING COSTS (continued)

	MILES	ANNUAL VEHICLE-MILES OF TRAFFIC	UNIT COST PER VEHICLE-MILE	TOTAL VEHICLE OPERATING COST
EAST ROUTE				
Interstate - Rural	35.2	12,501,615	$.1359	$1,698,918
Interstate - Frontage	6.1	2,019,545	.1241	250,661
Primary - Rural	24.7	1,542,855	.1452	224,041
Secondary - Rural	8.5	486,180	.1232	59,893
County Roads	15.0	139,795	.1598	22,333
City Streets	3.7	5,921,760	.1618	957,891
TOTAL	93.2	22,611,750	$.1421	$3,213,737
WEST ROUTE				
Interstate - Rural	39.2	13,358,635	$.1233	$1,647,714
Interstate - Frontage	- - -	- - -	- - -	- - -
Primary - Rural	26.6	3,986,895	.1405	560,287
Secondary - Rural	2.5	109,500	.1215	13,305
County Roads	11.5	83,950	.1765	14,821
City Streets	3.7	5,921,760	.1618	957,891
TOTAL	83.5	23,460,740	$.1361	$3,194,018

This table shows that all of the alternate route proposals would provide substantial savings in vehicle operating costs as compared with present operating conditions. The Middle Route, with an annual savings of $651,579 per year, would have the most favorable routing. The West Route, with annual savings of $586,946, would rank second in benefits, and the East Route, with annual savings of $567,227, would be the least favorable with regard to vehicle operating costs.

One of the principal factors favoring the Middle Route is the fact that the Middle Interstate Route will serve the greatest proportion of the total traffic as compared with the alternate routes. The Middle Interstate Route will serve 62.11% of all traffic in the analysis area, whereas the East Interstate Route will serve 55.29% of the total traffic, and the West Interstate Route will serve 56.94% of the total traffic. Since a higher proportion of the total traffic will be able to use a higher-standard Interstate facilities on the Middle Route, the overall travel cost for all traffic will be lower under this routing proposal.

It may be noted that the unit vehicle operating costs for Interstate-Rural travel is lowest on the West Route. This situation occurs because the West Route avoids most of the rise and fall which is encountered on the Middle Route and especially on the East Route. The East Route has the highest unit operating cost for Interstate - Rural travel for the reason that this route has an excessive amount of rise and fall and curvature as compared with the other alternate routes. The East Interstate Route also carries a higher proportion of truck traffic of through movement which increases the weighted average of passenger car and truck operating costs.

CONSTRUCTION COSTS

The Interstate Division has prepared an estimate of the costs involved in the construction of each alternate route to prescribed Interstate System standards. A summary of these costs, as classified by section and cost item, is included in the latter part of this report.

In order to make a direct comparison of construction costs with annual vehicle operating costs and annual maintenance costs, it is necessary to reduce the total construction costs to an annual cost basis. This is accomplished by dividing the total construction cost for each item by the estimated service life in years for that item. The results of these computations are shown in Table No. 4. The results show that the Middle Route has both the lowest overall cost and also the lowest annual cost.

The East Route has a comparatively high total cost because of the extensive amount of grading that is involved between Control Points E-6 and E-9. The costs of the East Route are also high because of the necessity of constructing a very long bridge over Holter Lake in the crossing to the east shore of this lake. Since four-lane highway is required throughout the length of the East Route, the construction costs are increased correspondingly.

In this analysis, no consideration has been given to the possibility that portions of present U.S. 91 would have to be reconstructed at some later date in order to continue serving traffic that would not be able to use either the East Route or the West Route if the Interstate System highway were to be built on either of these locations. Since the Middle Route would replace the service of the present highway with the exception of the Helena valley section, the reconstruction of the present highway would not present a problem in connection with that location.

If such reconstruction costs were taken into consideration, the results would be in favor of the Middle Route and would be adverse to the East Route or the West Route.

MAINTENANCE COSTS

Maintenance costs must also be taken into consideration in analyzing the merits of the alternate routes. In addition to the maintenance cost on the new Interstate System routes. It is also necessary to consider the maintenance costs on those sections of Primary and Secondary highway which would be kept in service for traffic that would not be served by the Interstate routes. Table No. 5 shows the estimated maintenance costs under the alternate routing proposals.

TABLE NO. 4

COMPARISON OF TOTAL AND ANNUAL CONSTRUCTION COSTS ON ALTERNATE INTERSTATE ROUTES

COST ITEM	YEARS OF LIFE	MIDDLE ROUTE		EAST ROUTE		WEST ROUTE	
		TOTAL	ANNUAL	TOTAL	ANNUAL	TOTAL	ANNUAL
Right-of-Way	50	$ 842,000	$ 16,840	$ 626,000	$ 12,520	$ 559,000	$ 11,180
Structures	50	3,634,000	72,680	4,145,000	82,900	3,917,000	78,340
Base and Surface	20	3,361,000	168,050	3,432,000	171,600	3,264,000	163,200
Traffic Services	20	419,000	20,950	411,000	20,550	532,000	26,600
Other Items	40	12,868,000	321,700	21,162,000	529,050	15,395,000	384,875
TOTAL		$21,124,000	$600,220	$29,776,000	$816,620	$23,667,000	$664,195
Route Length		37.6 miles		35.2 miles		39.2 miles	
Cost Per Mile		$561,809	$15,963	$845,909	$23,200	$603,750	$16,944
Average service life		35.2 years		36.5 years		35.6 years	

TABLE NO. 5

ESTIMATED MAINTENANCE COSTS

	ANNUAL COST PER MILE	MIDDLE ROUTE		EAST ROUTE		WEST ROUTE	
		MILES	COST	MILES	COST	MILES	COST
Primary System	$1,800	- - -	- - -	20.7	$37,260	24.1	$43,380
Secondary System	500	8.5	4,250	8.5	4,250	5.0	2,500
Frontage Road	500	6.1	3,050	6.1	3,050	- - -	- - -
County Roads	200	25.0	5,000	15.0	3,000	11.5	2,300
Interstate:							
2 lane	2,000	10.3	20,600	- - -	- - -	11.7	23,400
4 lane	3,500	27.3	95,550	35.2	123,200	27.5	96,250
Subtotal - Interstate		37.6	116,150	35.2	123,200	39.2	119,560
GRAND TOTAL- ALL SYSTEMS		77.2	$128,450	85.5	$170,760	79.8	$167,830
COST PER MILE - ALL SYSTEMS			$1,664		$1,997		$2,103

TABLE NO. 5

ESTIMATED MAINTENANCE COSTS

	ANNUAL COST PER MILE	MIDDLE ROUTE		EAST ROUTE		WEST ROUTE	
		MILES	COST	MILES	COST	MILES	COST
Primary System	$1,800	- - -	- - -	20.7	$37,260	24.1	$43,380
Secondary System	500	8.5	4,250	8.5	4,250	5.0	2,500
Frontage Road	500	6.1	3,050	6.1	3,050	- - -	- - -
County Roads	200	25.0	5,000	15.0	3,000	11.5	2,300
Interstate:							
2 lane	2,000	10.3	20,600	- - -	- - -	11.7	23,400
4 lane	3,500	27.3	95,550	35.2	123,200	27.5	96,250
Subtotal - Interstate		37.6	116,150	35.2	123,200	39.2	119,560
GRAND TOTAL- ALL SYSTEMS		77.2	$128,450	85.5	$170,760	79.8	$167,830
COST PER MILE - ALL SYSTEMS			$1,664		$1,997		$2,103

SUMMARY OF ALL COSTS

As explained in the foreword, it is necessary to consider the combination of construction, maintenance and vehicle operating costs for the alternate routes in order to determine which route has the most favorable routing from the standpoint of the highway user. The following table shows the combination of these costs for each route.

SUMMARY OF ALL COSTS FOR ALTERNATE ROUTING PROPOSALS

	MIDDLE ROUTE	EAST ROUTE	WEST ROUTE
ANNUAL CONSTRUCTION COST	$ 600,220	$ 816,620	$ 664,195
ANNUAL MAINTENANCE COST	128,450	170,760	167,830
ANNUAL OPERATING COST	3,129,385	3,213,737	3,194,018
TOTAL OF ALL COSTS	$3,858,055	$4,201,117	$4,026,043
ANNUAL SAVINGS IN FAVOR OF MIDDLE ROUTE		$343,062	$167,988

It may be noted from the above table that the Middle Route provides the most favorable location from the standpoint of annual construction cost, annual maintenance costs, annual vehicle operating costs and the total of all costs. On the basis of an estimated average life of 35 years for the construction components, the construction of the Middle Route would save the highway user $5,879,580 during this period as compared with the West Route. The lifetime savings for the Middle Route as compared with the East Route would amount to $12,007,170.

In the section pertaining to VEHICLE OPERATING COSTS, it was reported that the construction of new Interstate System highways on any of the alternate routes would produce substantial savings in vehicle operating costs for the highway-user. Such savings result because of the lower operating costs on the higher-standard Interstate facilities and the reduction of the total amount of travel required to reach the travel objective.

It was reported that the following annual savings would result in comparison with operating conditions on present roads and highways: Middle Route - $651,579; East Route - $567,227; West Route $586,946. These benefits were computed on the basis of present traffic volumes, but it is estimated that traffic over roads of these types should

double as an average during the estimated 35 year average service life for the Interstate highway components. Consequently, the benefits should also double and result in the following figures; Middle Route - $1,303,158; East Route - $1,134,454; West Route - $1,173,892.

The relationship between these annual benefits for each route and the corresponding construction and maintenance costs is revealed in a benefit/cost ratio. These ratios for each route are shown below:

	MIDDLE ROUTE		EAST ROUTE		WEST ROUTE	
	AMOUNTS	RATIO	AMOUNTS	RATIO	AMOUNTS	RATIO
ANNUAL BENEFITS	$1,303,158	1.7884	$1,134,454	1.1489	$1,173,892	1.4108
ANNUAL COSTS	$ 728,670		$ 987,380		$ 832,025	

These ratios reveal that $1.00 spent for construction and maintenance under the Middle Route proposal will produce savings in operating costs equal to $1.78. Similarly, $1.00 spent on the East Route will produce $1.15 in savings, and $1.00 spent on the West Route will save the highway-user $1.41 in operating costs.

CONCLUSIONS:

The results of this analysis support the selection of the Middle Route as the most favorable location for the Interstate highway on the basis of all factors which can be evaluated in monetary terms. The next most favorable location would be the West Route; however, the West Route would involve 11% higher annual construction costs, 31% higher annual maintenance costs, 2% higher vehicle operating costs and 4% higher composite costs for construction, maintenance and vehicle operation.

When the benefit/cost ratios are compared, the Middle Route would be 56% more favorable than the East Route and 27% more favorable than the West Route.

SUPPLEMENT

As a supplement to the principal analysis, it has been suggested that an alternate route be analyzed through the Helena valley. This route would follow the line of the West Route to a point near FAS Route 279 where the alternate route would veer in a northeasterly direction to a connection with the Middle Route at Control Point M-4. This alternate route would connect Control Points W-1, W-2, W-3, and M-4.

The purpose of the alternate routing is to determine whether it

would be economically sound to locate the route through the valley on the westerly line where it would miss most of the developed area of the valley, thereby reducing the disruption of present development in the valley but increasing the length of the route and increasing the travel distance for all but a small portion of the traffic.

These routes will be identified as the Middle Route and the West Route in this section of the analysis.

The following table shows the total cost of construction on each of these routes and the corresponding annual cost based on the estimated service lives for each of the principal construction cost items.

COMPARISON OF CONSTRUCTION COSTS

COST ITEM	YEARS OF LIFE	MIDDLE ROUTE TOTAL COST	MIDDLE ROUTE ANNUAL COST	WEST ROUTE TOTAL COST	WEST ROUTE ANNUAL COST
Right-of-Way	50	$ 550,000	$ 11,000	$ 279,000	$ 5,580
Structures	50	1,162,000	23,240	1,430,000	28,600
Base & surface	20	1,286,000	64,300	1,404,000	70,200
Traffic Services	20	110,000	5,500	112,000	5,600
Other Items	40	1,647,000	41,175	1,484,000	37,100
TOTAL		$4,755,000	$145,215	$4,709,000	$147,080
Route Length		9.5 miles		11.1 miles	
Cost Per Mile		$500,526	$15,286	$ 424,234	$13,250
Average Service Life		32.7 years		32.0 years	

The following table shows the estimated cost of maintaining the necessary highway facilities involved under each of the alternate Interstate routing proposals. In addition to the maintenance of the Interstate highways for each route, it would also be necessary to maintain present

highway U.S. 91 to serve local traffic not using either of the Interstate System highways between Control Points M-1 and M-4. If the Middle Interstate Route were to be constructed, it would also be necessary to maintain a frontage road on the east side of that highway. Such a frontage road would not be necessary if the West Interstate Route were to be constructed.

COMPARISON OF MAINTENANCE COSTS

TYPE OF HIGHWAY	ANNUAL COST PER MILE	MIDDLE ROUTE MILES	MIDDLE ROUTE COST	WEST ROUTE MILES	WEST ROUTE COST
Interstate 4-lane	$2,500	9.5	$23,750	11.1	$27,750
Primary 2-lane	1,800	6.5	11,700	6.5	11,700
Frontage 2-lane	1,000	6.5	6,500	- - -	- - -
TOTAL		22.5	$41,950	17.6	$39,450

The following shows the total annual cost for construction and maintenance on the alternate routing proposals:

	MIDDLE ROUTE	WEST ROUTE
ANNUAL CONSTRUCTION COST	$145,215	$147,080
ANNUAL MAINTENANCE COST	41,950	39,450
TOTAL	$187,165	$186,530

It may be noted that there is a difference of only $635.00 in the annual cost of constructing and maintaining the necessary highway facilities under each of the two alternate routing proposals. It may be assumed, therefore, that the two routes have an equal rating insofar as these costs are concerned.

For traffic assignment purposes, the traffic has been segregated into two separate categories. The first category includes through traffic with origins and destinations beyond the common termini for the two routes. This type of traffic consists of 960 vehicles per day which would have to travel 1.6 miles per trip farther via the West Route as compared with the Middle Route. When expanded to an annual figure, this traffic would travel

560,640 additional vehicle-miles via the West Route. At a cost of $.1150 per vehicle mile for Interstate System travel, this extra cost via the West Route would amount to $64,474 per year.

The second category of traffic includes the vehicles moving onto the Interstate System from FAS Routes 279 and 453 at the north edge of the Helena valley. If the Interstate highway were to be located on the West Route, the travel to reach the highway from the west would be about 1.5 shorter than the travel to the Middle Route. Conversely, if the Interstate highway were to be located on the Middle Route, the travel from the east to the Interstate highway would be about 1.5 miles shorter than it would be to the West Route.

Since the traffic volumes from the east and the west are about equal, there would be very little difference in the amount of travel required to reach the Interstate highway itself. There would be a substantial difference, however, in the amount of travel involved in the use of the Interstate highway from the north edge of the valley to Helena and points beyond.

The West Interstate Route between these points is about 1.5 miles longer than the Middle Route. In order to use the West Route, 392 vehicles per day would have to travel about 1.5 miles farther at a cost of $.1152 per vehicle mile. When expanded to an annual cost figure, the West Route would cost this traffic $24,724 more than similar travel via the Middle Route.

The addition of this figure of $24,724 per year to the previous figure of $64,474 per year produces a total cost of $89,198 per year more for travel via the West Route as compared with the Middle Route.

On the basis of these computations, it must be concluded that the Middle Route across the Helena valley would be most favorable to the highway user.

PRELIMINARY COST ESTIMATE

SHEET 1 OF 3

PROJECT Helena - Wolf Creek

LOCATION Approximate PTW Alternate (Middle Route)

Section	M1 - M4	M4 - M5	M5 - M6	M6 - M9	M9 - M10		TOTAL					
Length, miles	9.5	8.6	7.6	9.2	2.7		37.6					
1975 DHV	655	460	460	470	420		--					
Number of lanes	4	4	2	4	2		--					
WORK CLASSIFICATION	ESTIMATED COSTS (1,000 Dollars)											
1. Preliminary engineering	176	159	46	426	41		848					
2. Right-of-Way	550	36	15	225	16		842					
3. Clear & grub; demolition	--	61	5	74	37		177					
4. Utility adjustments	28	--	--	56	2		86					
5. Grade & drain; minor structures	1057	1942	409	6331	147		9886					
6. Base; surfacing; shoulders	1286	791	403	756	125		3361					
7. R. R. grade separations	569	--	--	600	--		1169					
8. Highway grade separations without ramps	181	28	--	65	--		274					
9. Interchanges, complete	287	384	104	397	126		1298					
10. Other bridges; tunnels	125	--	--	384	384		893					
11. Walls	--	--	--	--	--		--					
12. Guardrail; fencing; lighting; traffic control devices	110	71	31	164	43		419					
13. Roadside improvement	--	15	--	--	--		15					
14. All other items	20	20	--	50	--		90					
15. Subtotal, lines 3 to 14	3663	3312	952	8877	864		17668					
16. Construction Engineering & Contingencies, 10% of line 15	366	331	95	888	86		1766					
17. Total Estimated Cost	4755	3838	1108	10416	1007		21124					

PRELIMINARY COST ESTIMATE

SHEET 2 OF 3

PROJECT Helena - Wolf Creek

LOCATION Silver City Alternate (West Route)

Section	W1 - W2	W2 - W3	W3 - W4	W4 - W5	W5 - W6	W6 - W7	M6 - M9	M9 - M10		TOTAL		
Length, miles	4.4	4.6	4.1	5.3	5.2	3.7	9.2	2.7		39.2		
1975 DHV	550	515	460	400	390	390	470	420				
Number of lanes	4	4	4	2	4	2	4	2		--		
WORK CLASSIFICATION	ESTIMATED COSTS (1,000 Dollars)											
1. Preliminary engineering	94	59	59	37	220	29	426	41		965		
2. Right-of-Way	111	116	12	32	10	37	225	16		559		
3. Clear & grub; demolition	--	37	20	--	42	15	74	37		225		
4. Utility adjustments	2	2	--	--	90	--	56	2		152		
5. Grade & drain; minor structures	355	326	584	226	3810	170	6331	147		11949		
6. Base; surfacing; shoulders	570	572	377	271	404	189	756	125		3264		
7. R. R. grade separations	569	--	--	--	216	80	600	--		1465		
8. Highway grade separations without ramps	181	--	--	59	--	--	65	--		305		
9. Interchanges, complete	191	186	174	132	--	128	397	126		1334		
10. Other bridges; tunnels	45	--	--	--	--	--	384	384		813		
11. Walls	--	--	--	--	--	--	--	--		--		
12. Guardrail; fencing; lighting; traffic control devices	46	63	81	83	27	25	164	43		532		
13. Roadside improvement	--	--	--	--	--	--	--	--		--		
14. All other items	--	40	--	--	--	--	50	--		90		
15. Subtotal, lines 3 to 14	1959	1226	1236	771	4589	607	8877	864		20129		
16. Construction Engineering & Contingencies, 10% of line 15	196	123	124	77	459	61	888	86		2014		
17. Total Estimated Cost	2360	1524	1431	917	5278	734	10416	1007		23667		

PRELIMINARY COST ESTIMATE

SHEET 3 OF 3

PROJECT Helena - Wolf Creek

LOCATION Holter Lake Alternate (East Route)

Section	M1 - M4	M4 - M5	E5 - E6	E6 - E7	E7 - E8	E8 - E9		TOTAL				
Length, miles	9.5	8.6	0.9	6.4	4.5	5.3		35.2				
1975 DHV	655	460	380	380	380	385						
Number of lanes	4	4	4	4	4	4		--				
WORK CLASSIFICATION	ESTIMATED COSTS (1,000 Dollars)											
1. Preliminary engineering	176	159	11	638	161	74		1219				
2. Right-of-Way	550	36	4	6	14	16		626				
3. Clear & grub; demolition	--	61	--	64	54	26		205				
4. Utility adjustments	28	--	--	--	--	--		28				
5. Grade & drain; minor structures	1057	1942	122	10380	2672	944		17117				
6. Base; surfacing; shoulders	1286	791	93	478	336	448		3432				
7. R. R. grade separations	569	--	--	--	--	--		569				
8. Highway grade separations without ramps	181	28	--	--	--	--		209				
9. Interchanges, complete	287	384	--	--	194	127		992				
10. Other bridges; tunnels	125	--	--	2250	--	--		2375				
11. Walls	--	--	--	--	--	--		--				
12. Guardrail; fencing; lighting; traffic control devices	110	71	10	129	91	--		411				
13. Roadside improvement	--	15	--	--	--	--		15				
14. All other items	20	20	--	--	--	--		40				
15. Subtotal, lines 3 to 14	3663	3312	225	13301	3347	1545		25393				
16. Construction Engineering & Contingencies, 10% of line 15	366	331	22	1330	335	154		2538				
17. Total Estimated Cost	4755	3838	262	15275	3857	1789		29776				

PRELIMINARY COST ESTIMATE

SHEET 1 OF 1

PROJECT Helena - North

LOCATION Helena Valley

Section	M1 - M4					W1 - W2	W2 - M4		TOTAL			
Length, miles	9.5					4.4	6.7		11.1			
1975 DHV	655					600	540					
Number of lanes	4					4	4		--			
WORK CLASSIFICATION	ESTIMATED COSTS (1,000 Dollars)											
1. Preliminary engineering	176					94	91		185			
2. Right-of-Way	550					111	168		279			
3. Clear & grub; demolition	--					--	--		--			
4. Utility adjustments	28					2	2		4			
5. Grade & drain; minor structures	1057					355	534		889			
6. Base; surfacing; shoulders	1286					570	834		1404			
7. R. R. grade separations	569					569	--		569			
8. Highway grade separations without ramps	181					181	250		431			
9. Interchanges, complete	287					191	194		385			
10. Other bridges; tunnels	125					45	--		45			
11. Walls	--					--	--		--			
12. Guardrail; fencing; lighting; traffic control devices	110					46	66		112			
13. Roadside improvement	--					--	--		--			
14. All other items	20					--	20		20			
15. Subtotal, lines 3 to 14	3663					1959	1900		3859			
16. Construction Engineering & Contingencies, 10% of line 15	366					196	190		386			
17. Total Estimated Cost	4755					2360	2349		4709			

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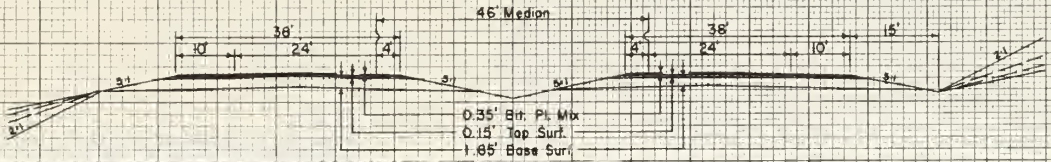

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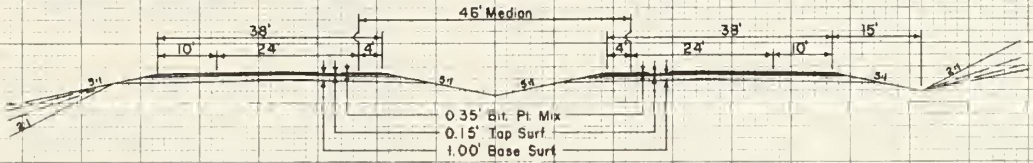

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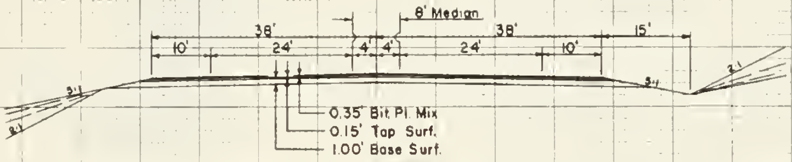

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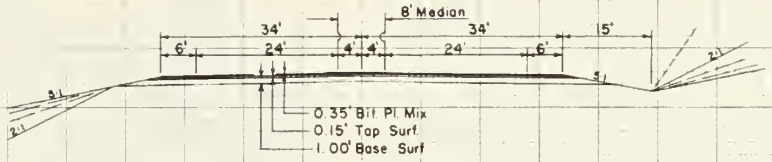

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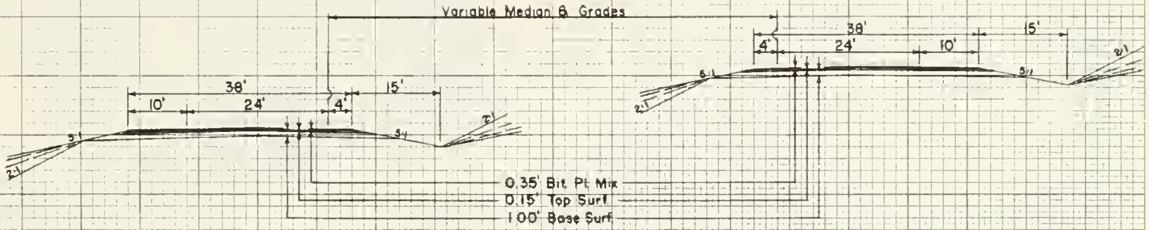

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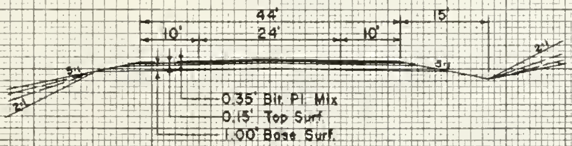

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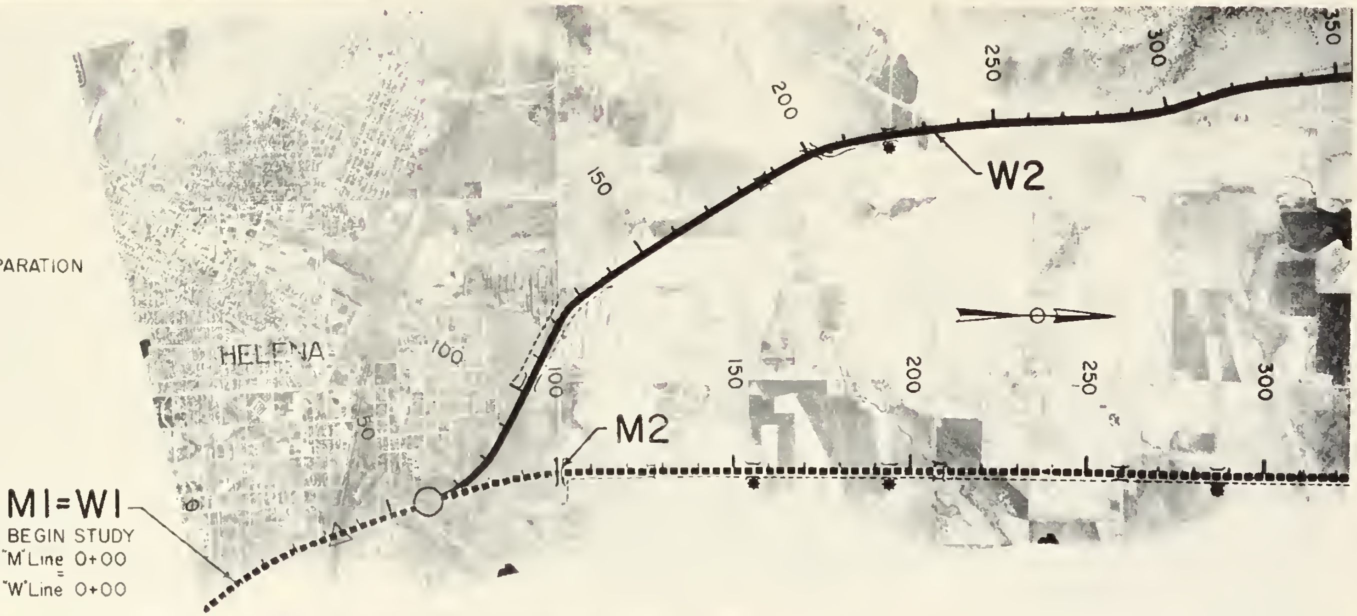
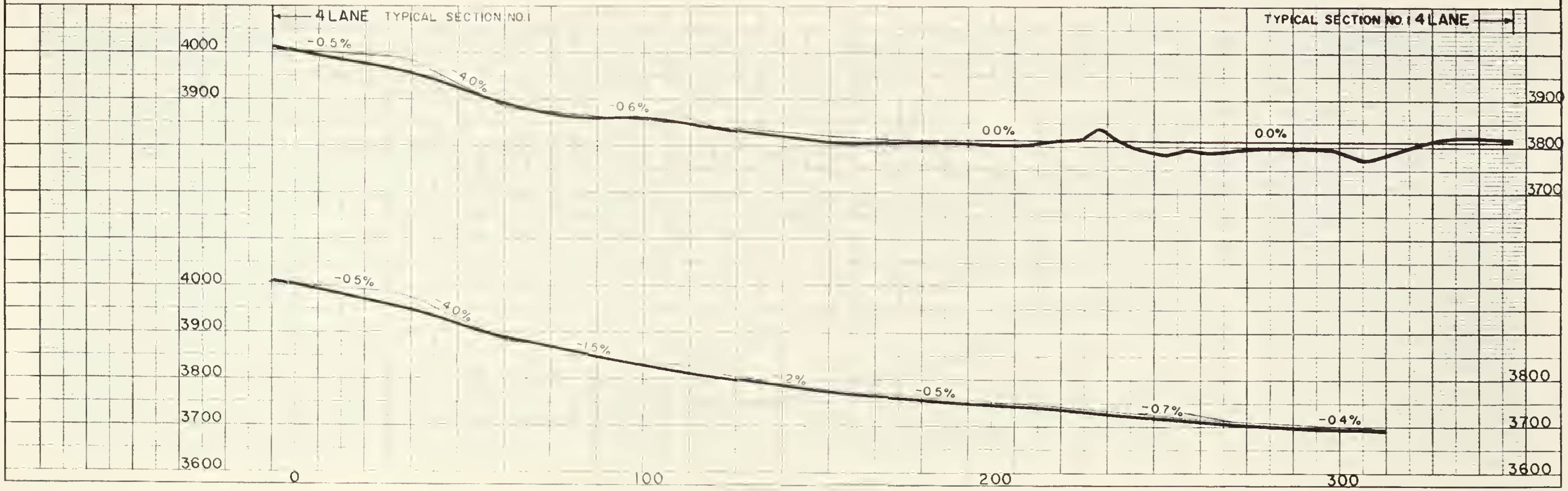
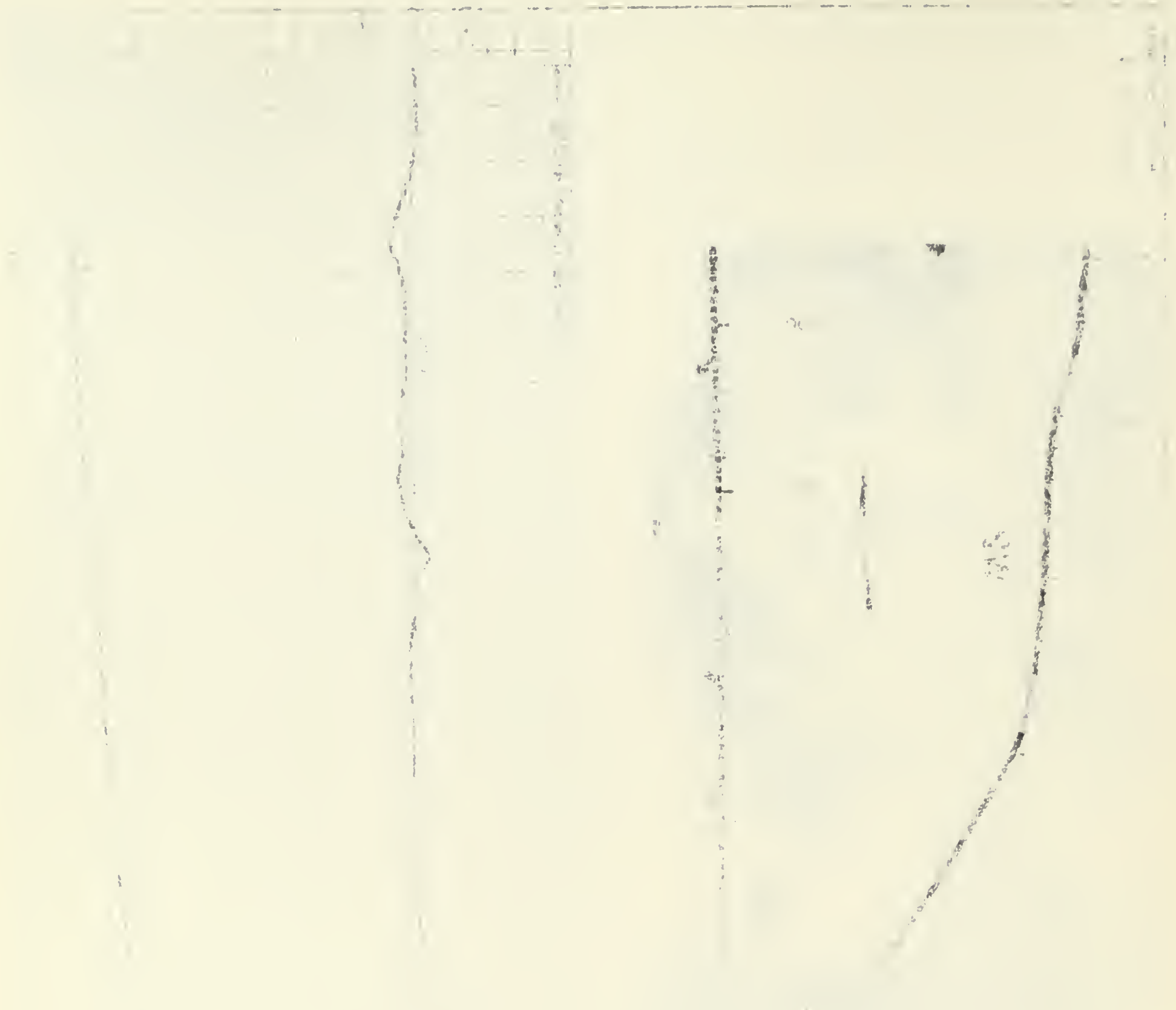
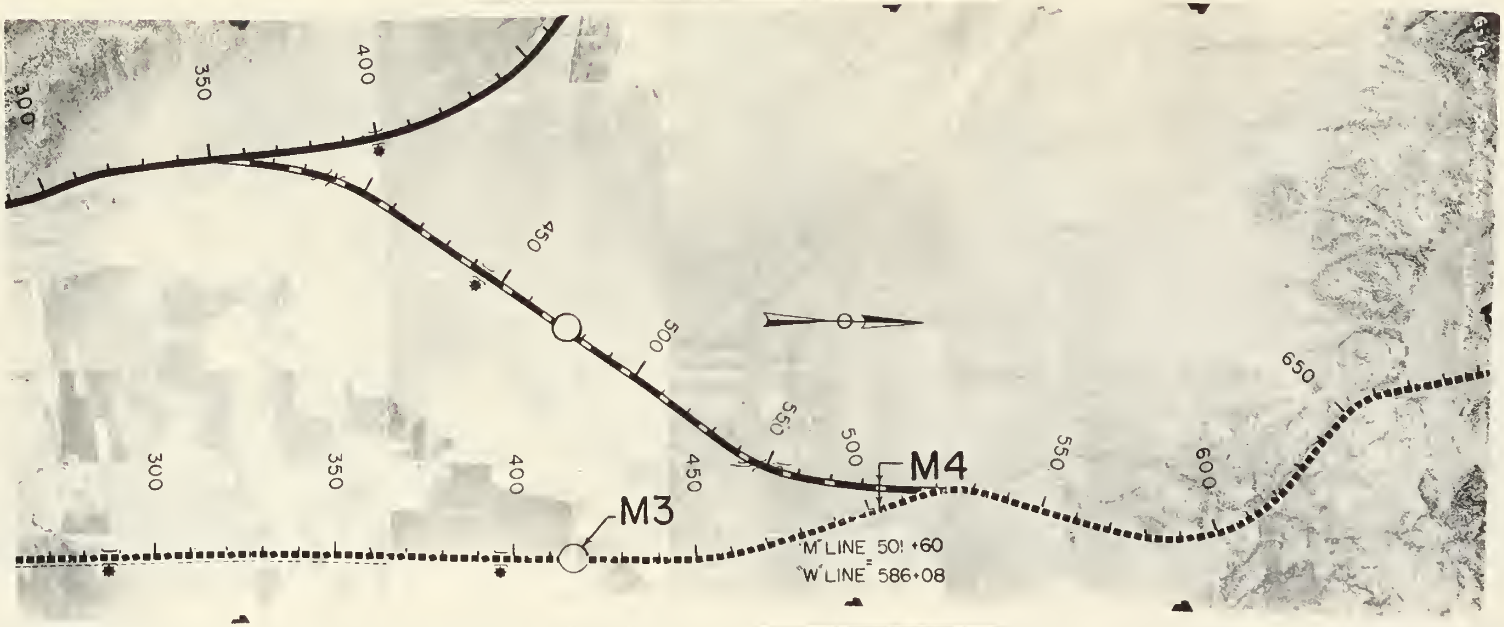
- RAILROAD SEPARATION
- AT GRADE INTERSECTION
- GRADE SEPARATION
- BRIDGE
- SINGLE LANE GRADE SEPARATION

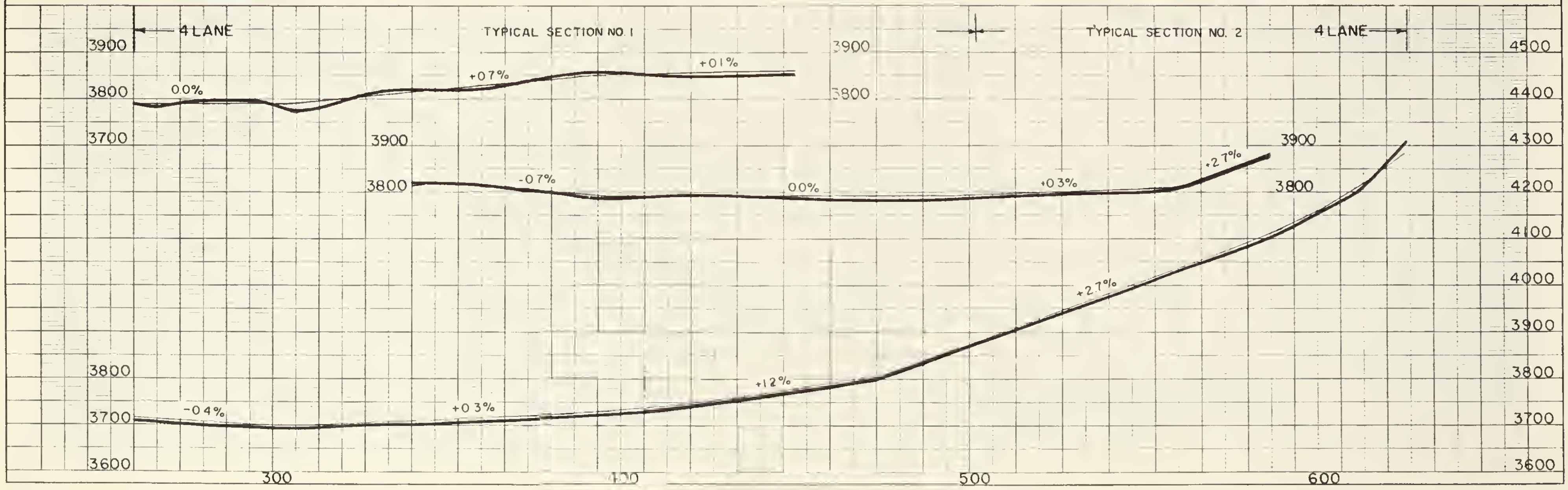






HELENA- WOLF CREEK
SHEET 2 OF 14





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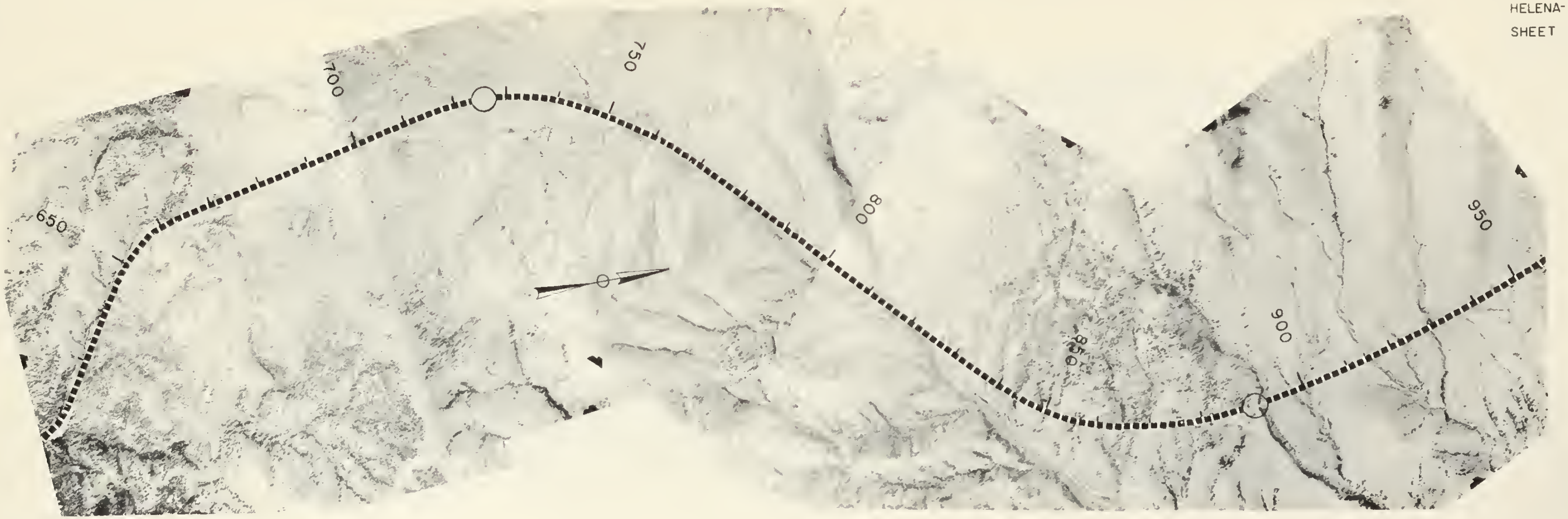
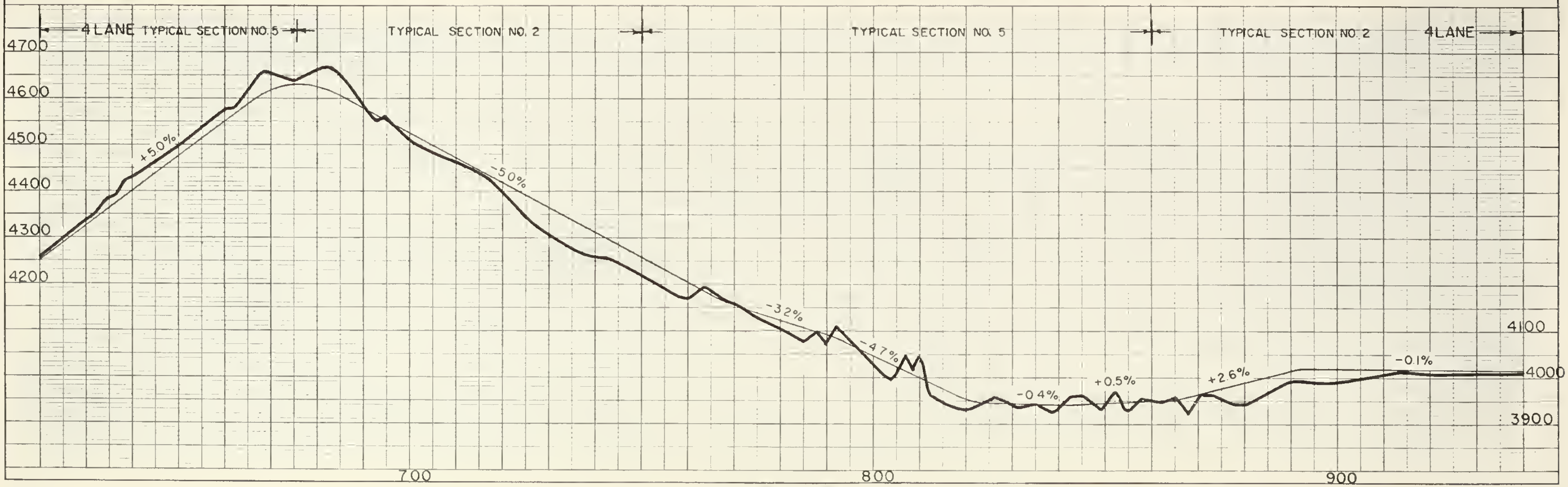
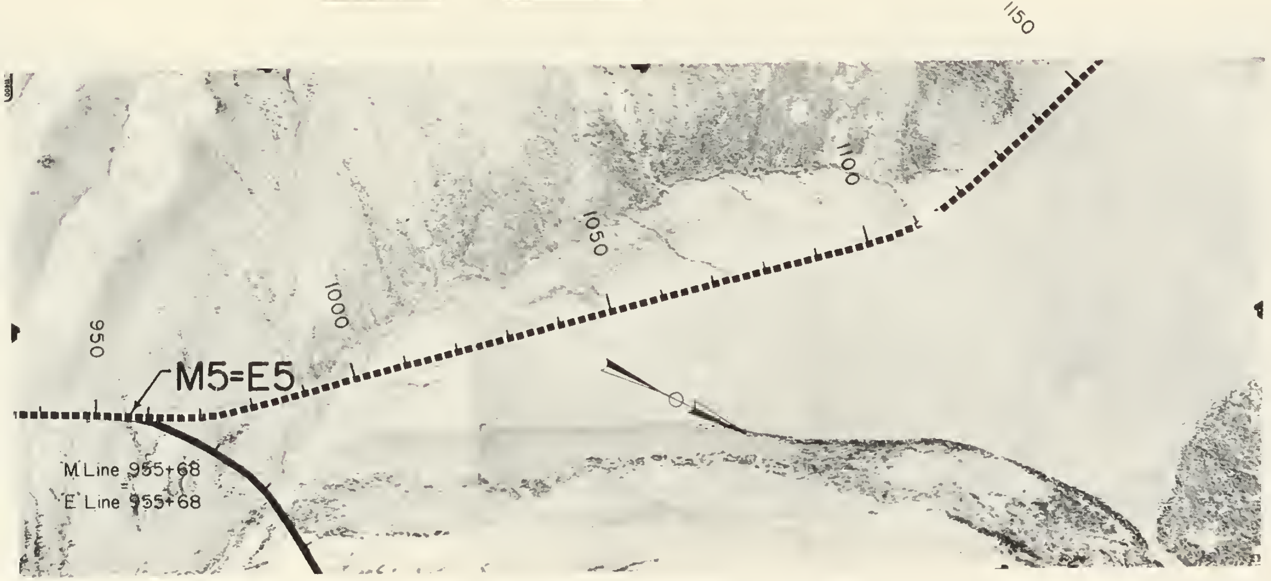
SHEET 3 OF 14



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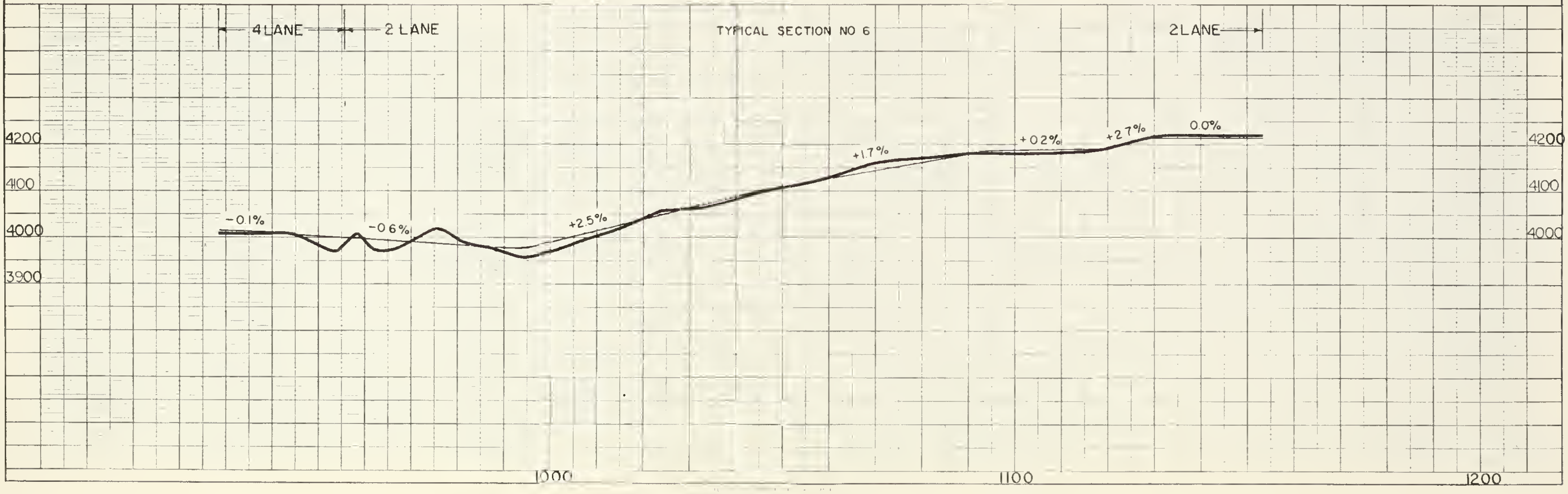
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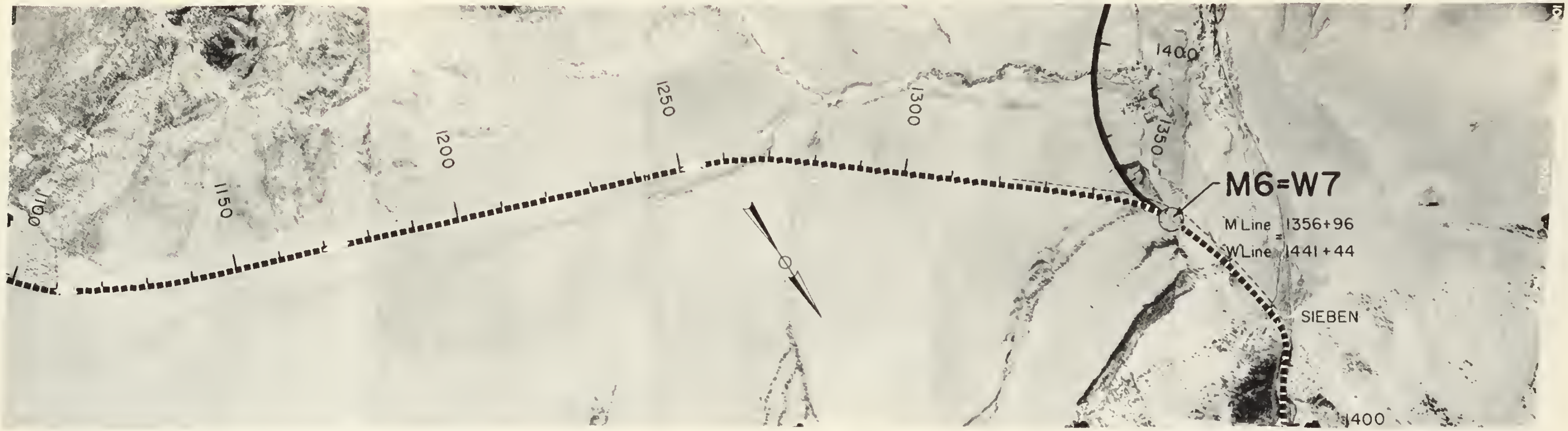
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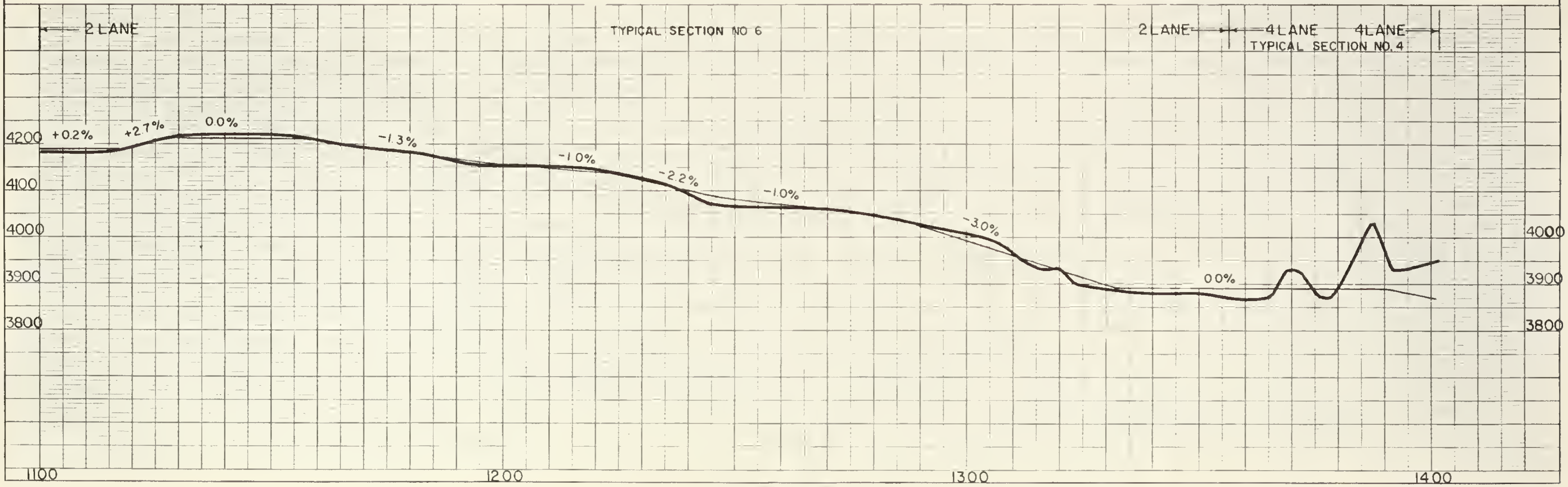
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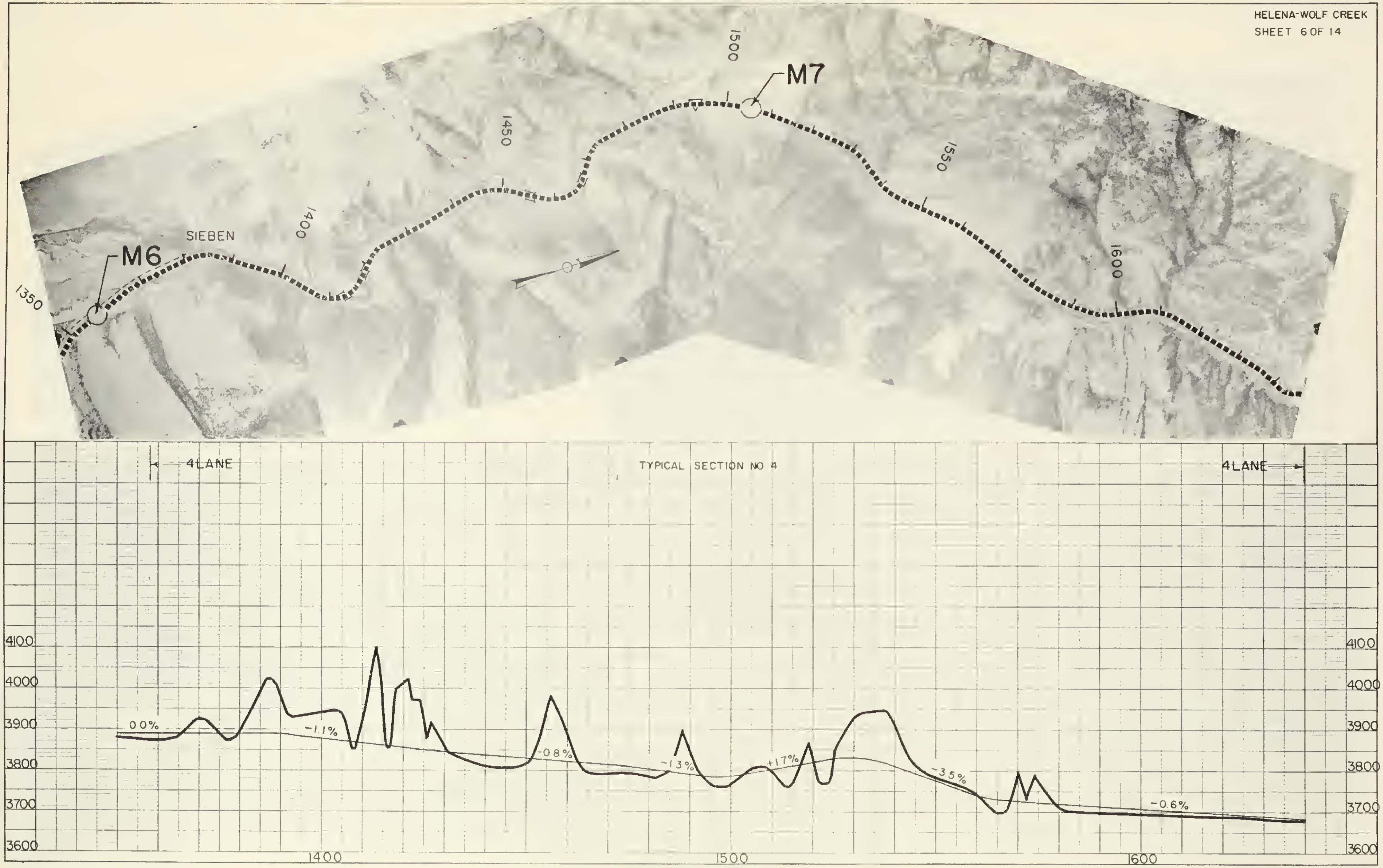
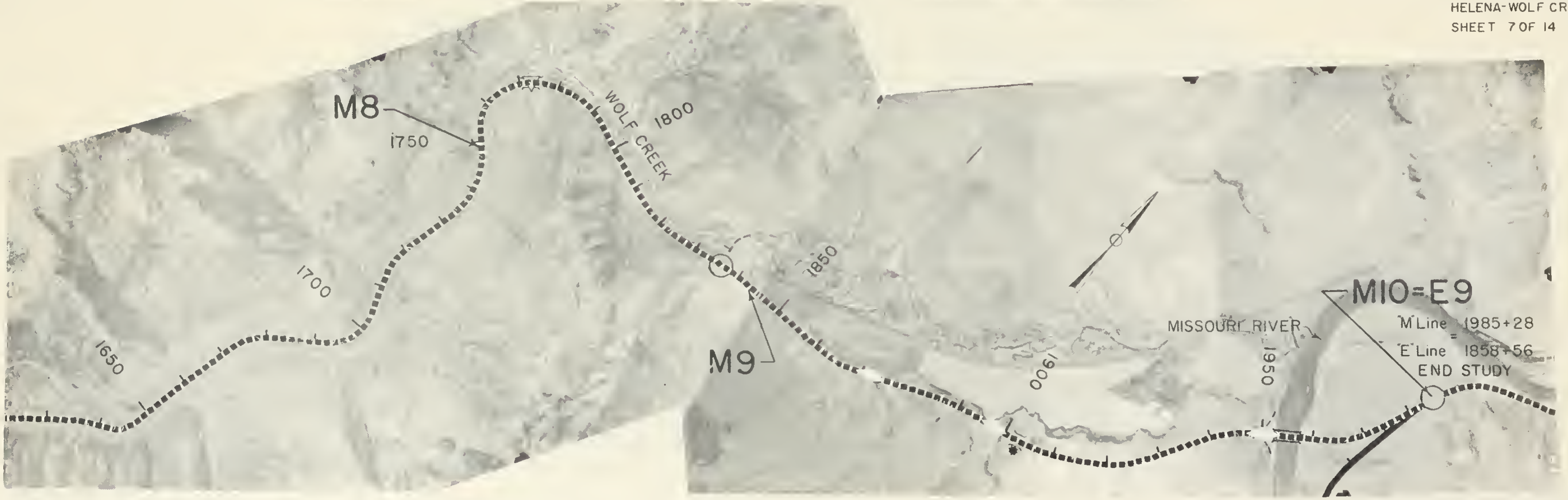


HELENA-WOLF CREEK
SHEET 6 OF 14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1700
1650
1850
M9
1900
1950
MISSOURI RIVER
M10=E9
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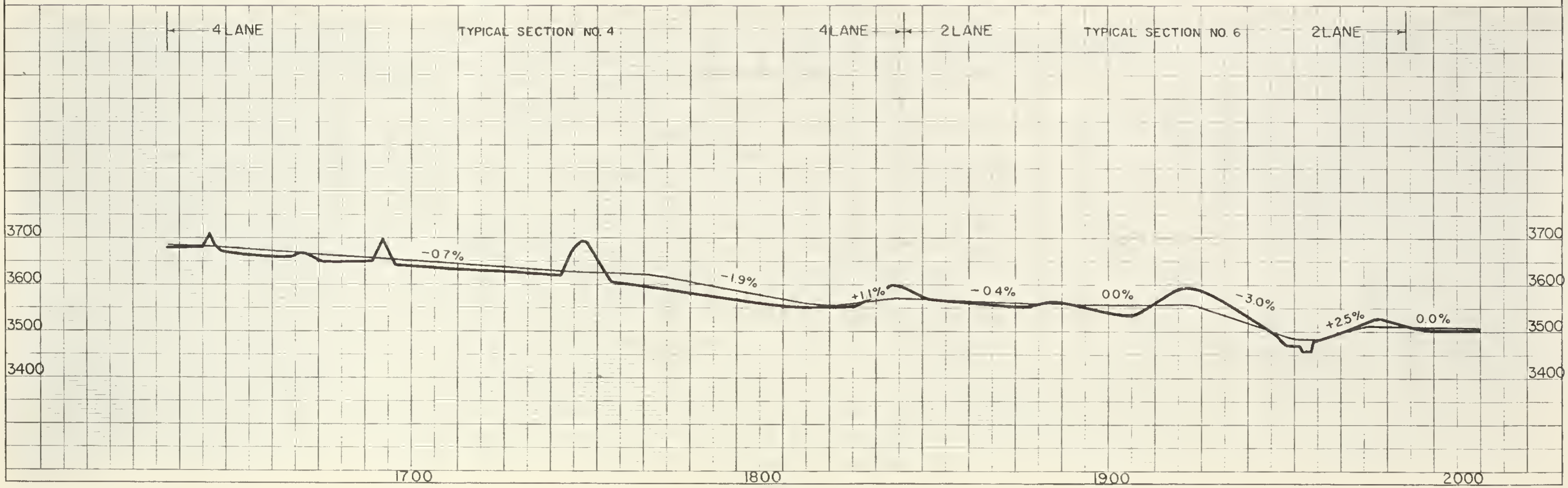
=
'E' Line 1858+56
END STUDY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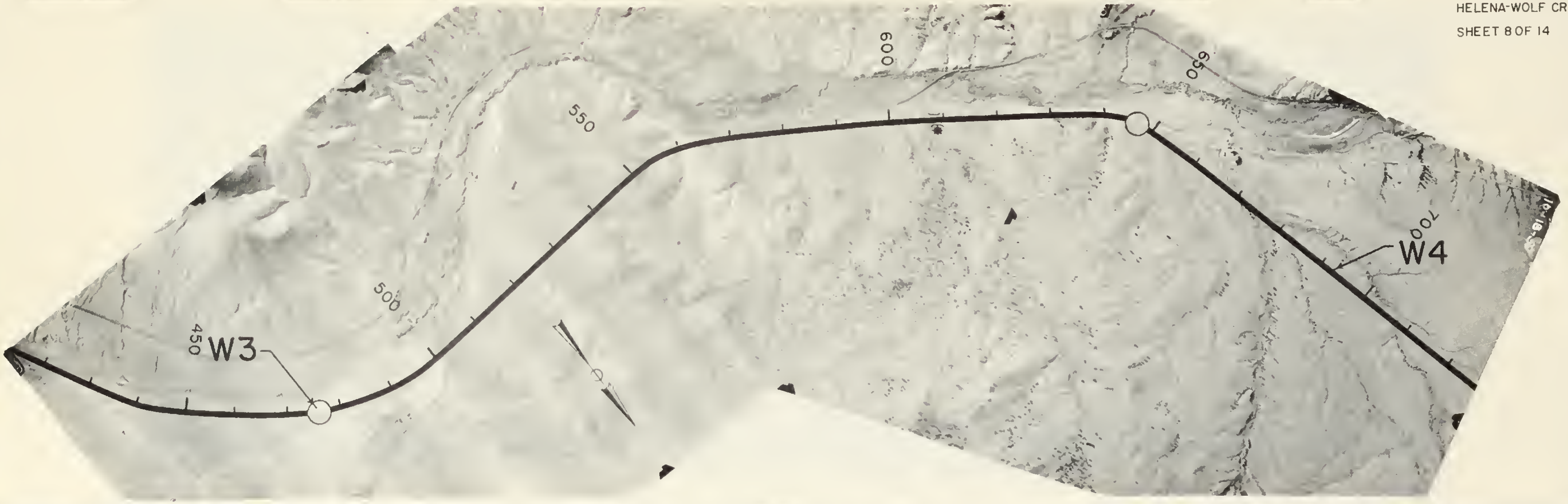
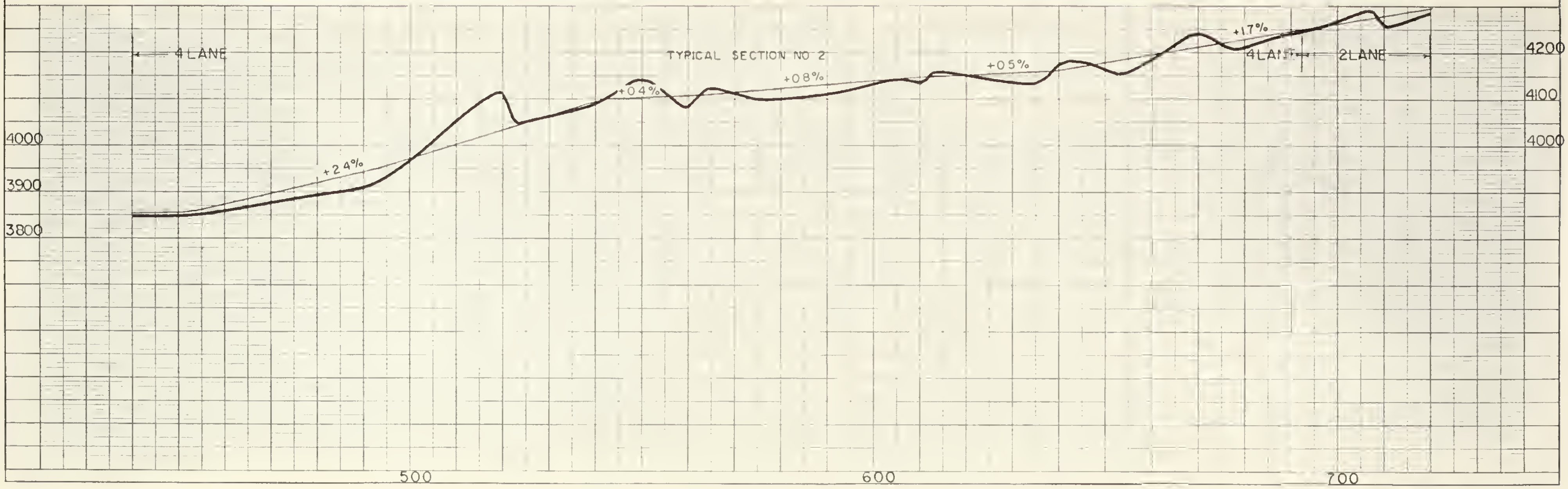
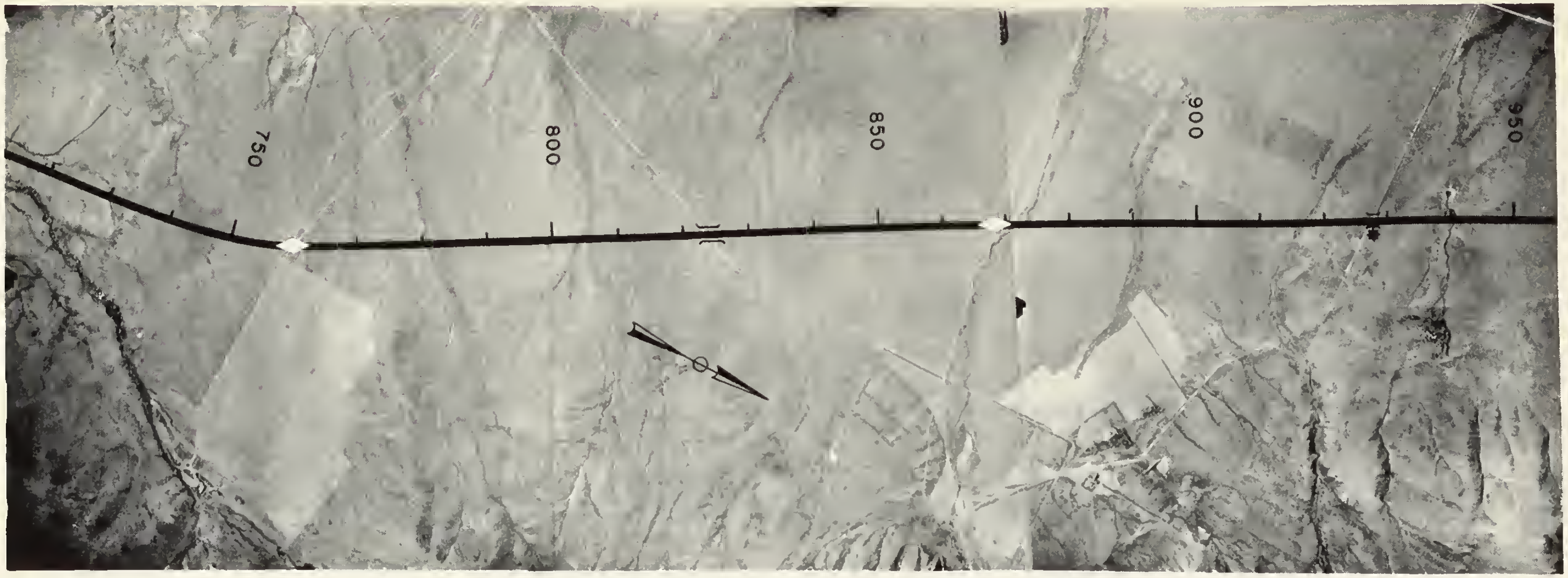
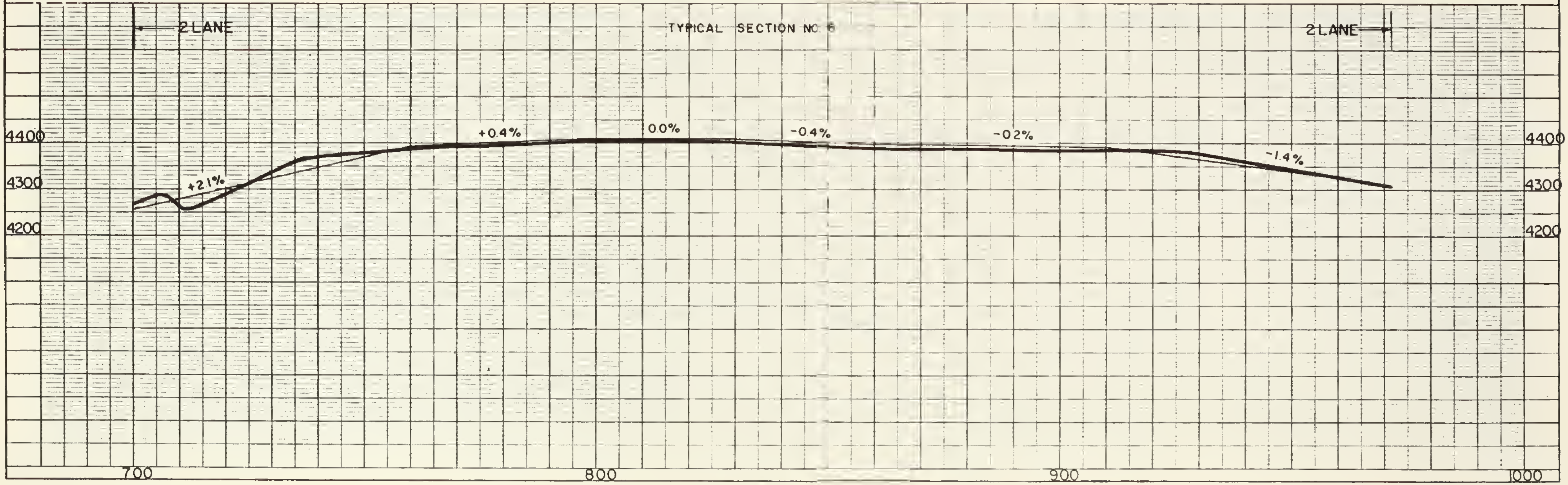
HELENA-WOLF CREEK
SHEET 8 OF 14

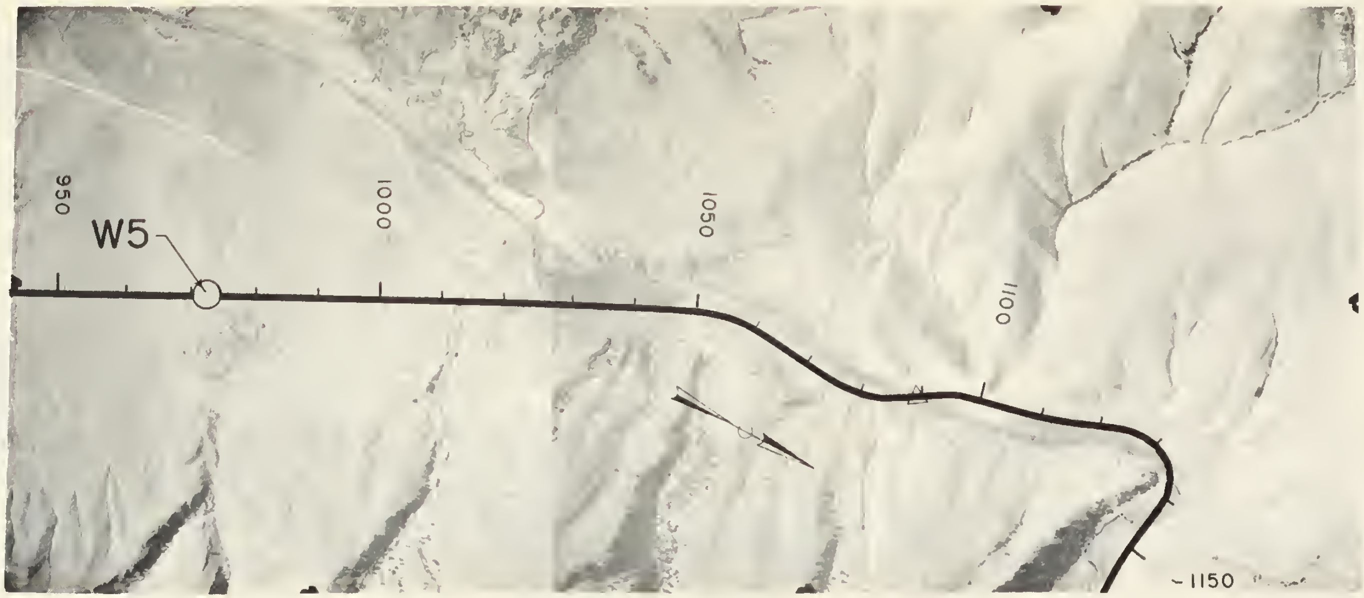


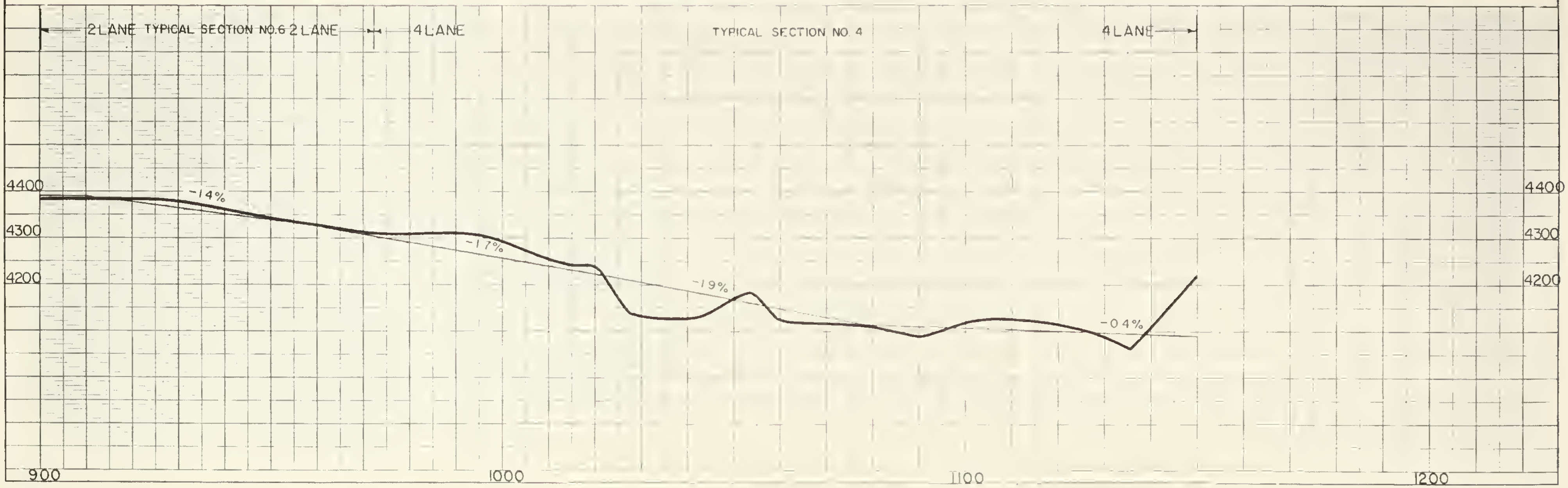


HELENA-WOLF CREEK
SHEET 9 OF 14

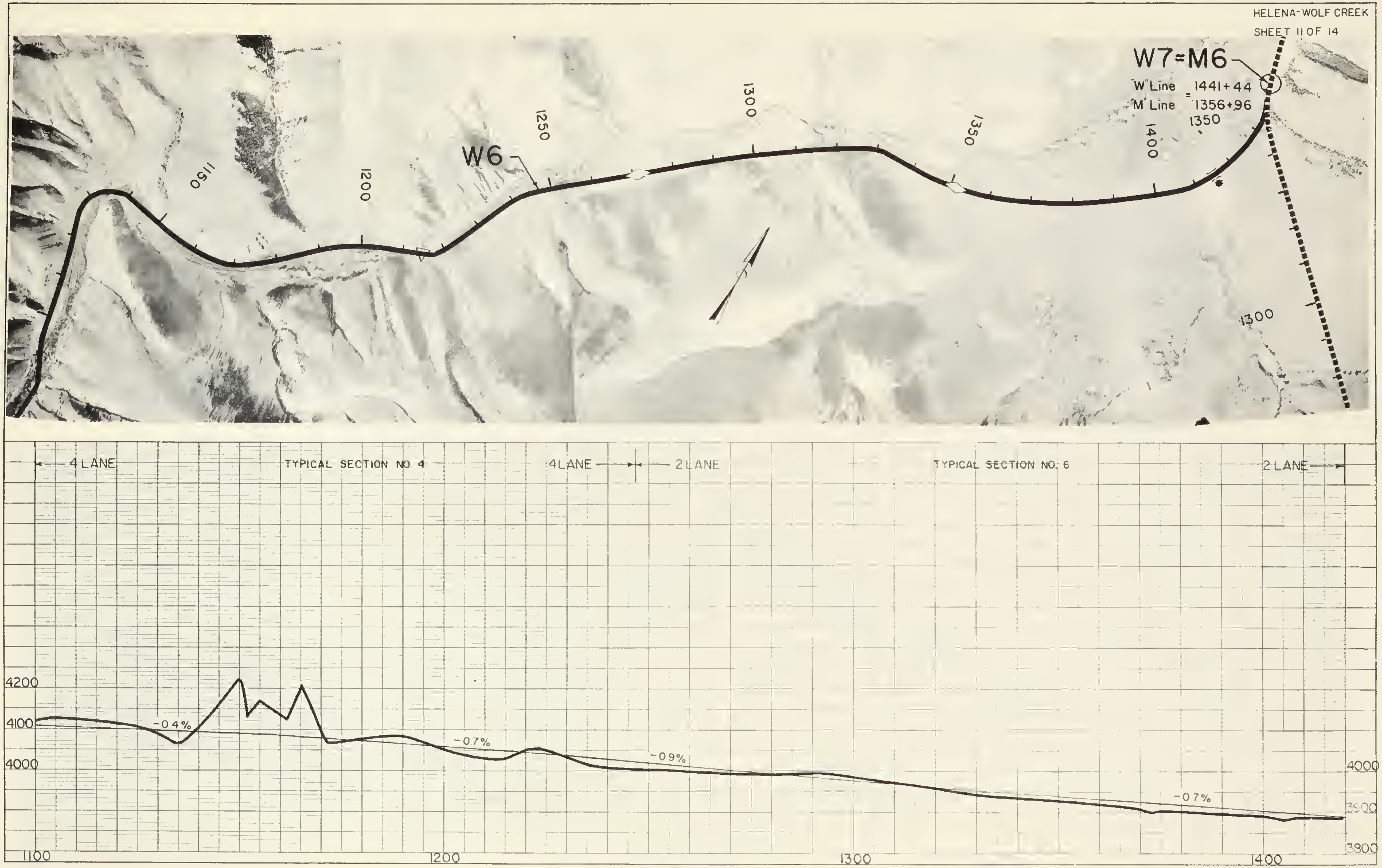


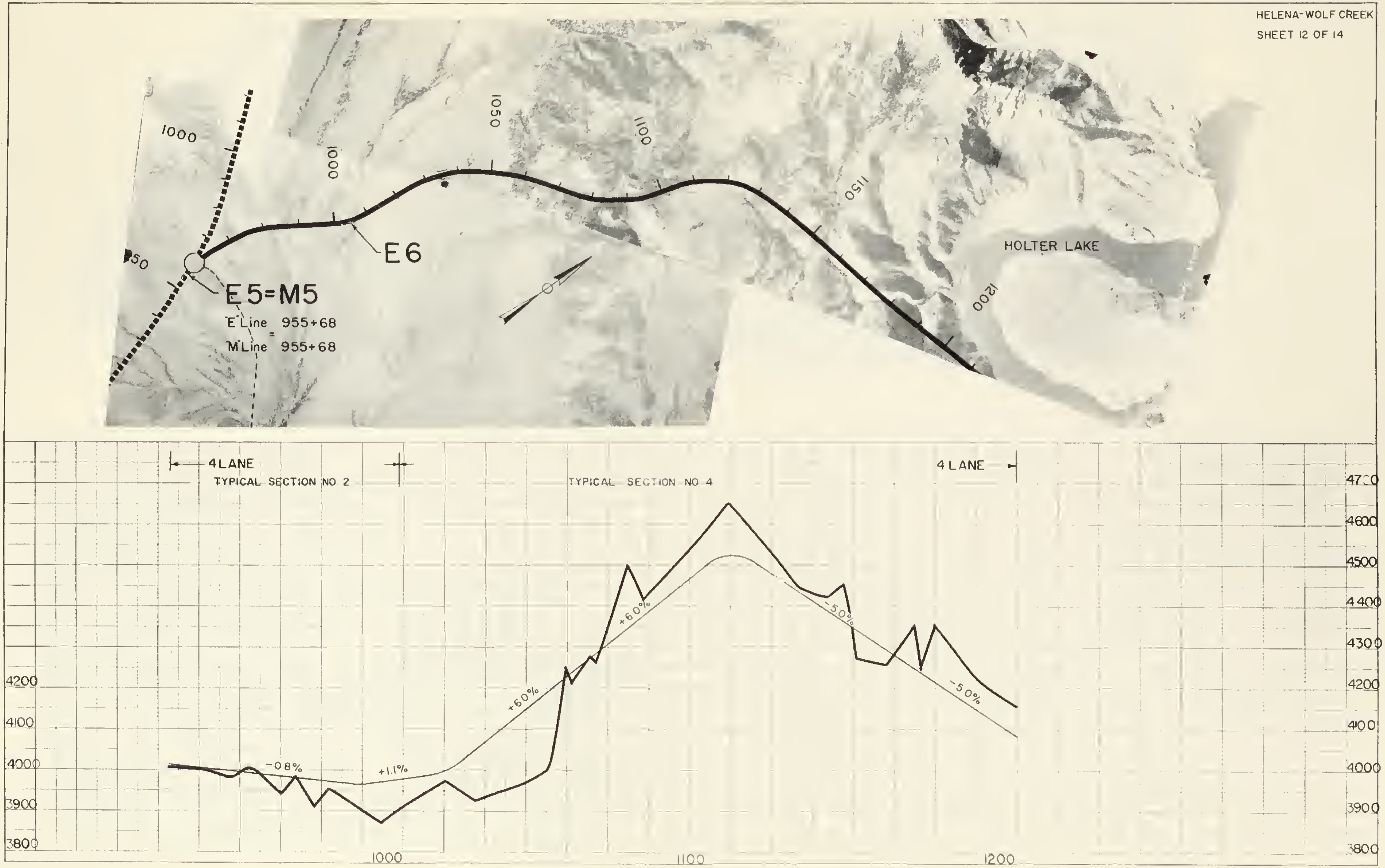


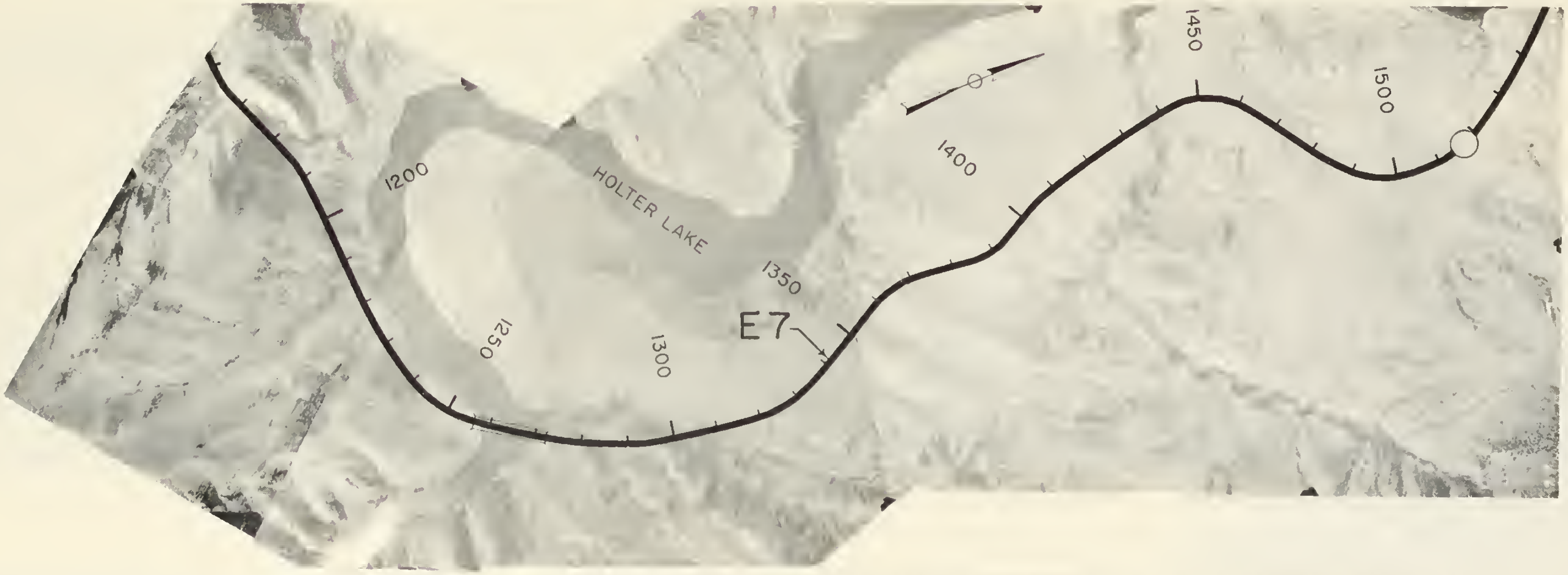

950
W5
1000
1050
1100
-1150

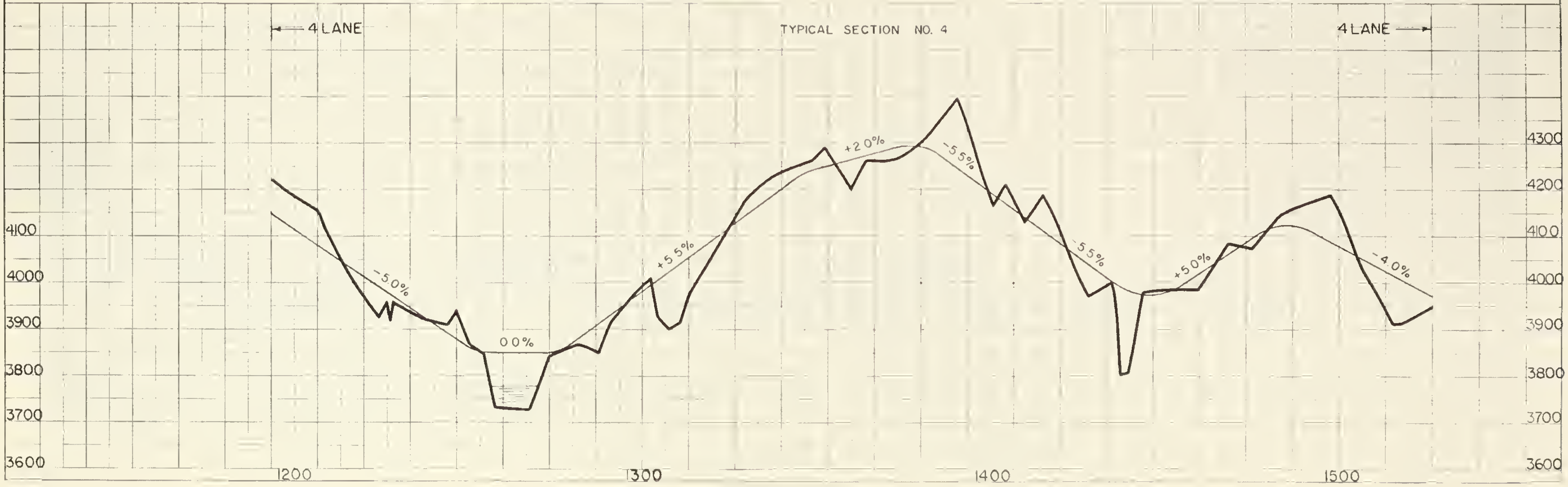

2 LANE TYPICAL SECTION NO.6 2 LANE
4 LANE
TYPICAL SECTION NO. 4
4 LANE
4400
4300
4200
-1.4%
-1.7%
-1.9%
-0.4%
900
1000
1100
1200

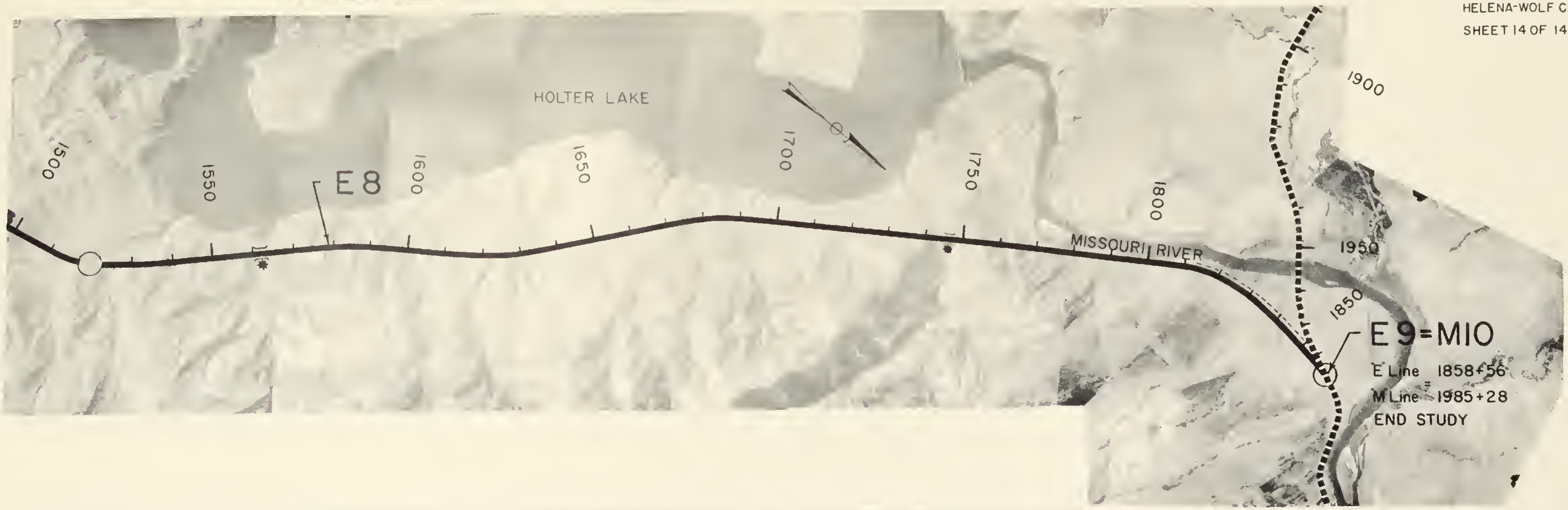
HELENA-WOLF CREEK
SHEET 11 OF 14

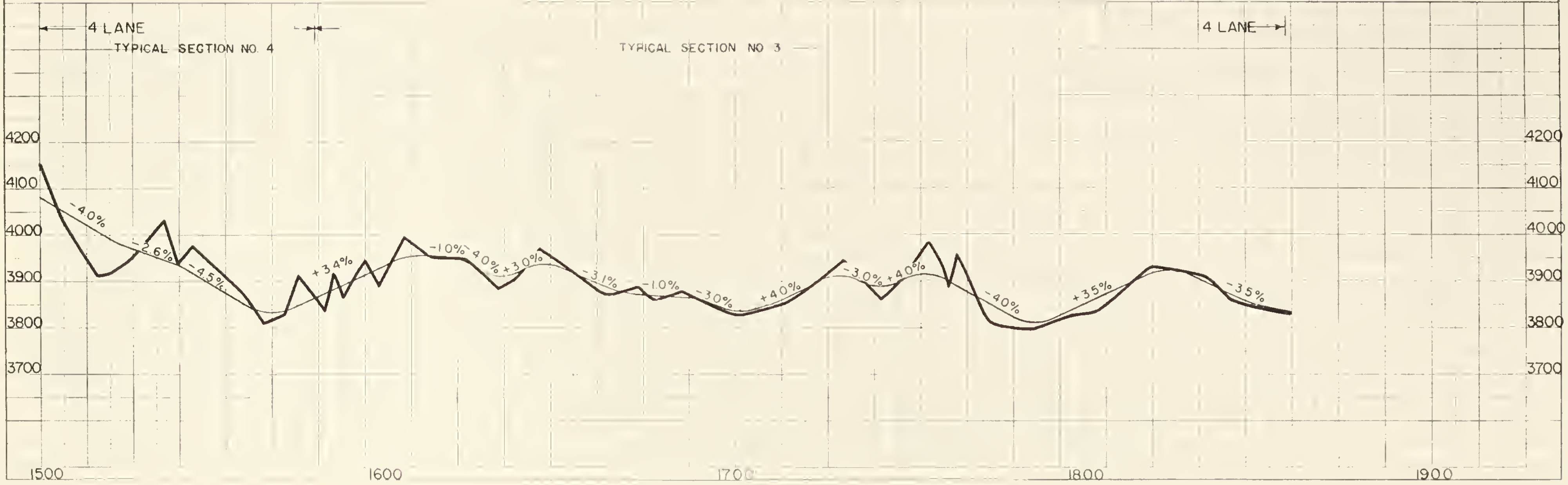



1000
1000
1050
1100
1150
1200
50
E6
E5=M5
E Line 955+68
=
M Line 955+68
HOLTER LAKE
4 LANE
TYPICAL SECTION NO. 2
TYPICAL SECTION NO. 4
4 LANE
-0.8%
+1.1%
+6.0%
+6.0%
-5.0%
-5.0%
4700
4600
4500
4400
4300
4200
4100
4000
3900
3800
1000
1100
1200


1200
1250
1300
1350
1400
1450
1500
HOLTER LAKE
E7


4 LANE
TYPICAL SECTION NO. 4
4 LANE
-5.0%
0.0%
+5.5%
+2.0%
-5.5%
-5.5%
+5.0%
-4.0%
4100
4000
3900
3800
3700
3600
4300
4200
4100
4000
3900
3800
3700
3600
1200
1300
1400
1500


HOLTER LAKE
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
E8
MISSOURI RIVER
E9=M10
E Line 1858+56
M Line = 1985+28
END STUDY


4 LANE
TYPICAL SECTION NO. 4
TYPICAL SECTION NO 3
4 LANE
4200
4100
4000
3900
3800
3700
-4.0%
-2.6%
-4.5%
+3.4%
-1.0%
4.0%
+3.0%
-3.1%
-1.0%
-3.0%
+4.0%
-3.0%
+4.0%
-4.0%
+3.5%
-3.5%
1500
1600
1700
1800
1900